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Yours Truly
Franklin Wells

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FRANKLIN WELLS.

Hon. Franklin Wells, who has just been reappointed (January, 1895), a member of the State Board of Agriculture, has served continuously on the board since 1873, having been appointed by Gov. Bagley, and has, since 1884, been president of the board.

Mr. Wells was born in Salem, Washington county, New York, April 19, 1823, and came to Michigan with his parents in 1837, remaining on the farm where they settled, near White Pigeon, St. Joseph county, for about a year, when he entered the store of W. T. House & Co., at Constantine, where he remained as clerk until 1841; he then went into the counting house of Jos. R. Williams & Co. as bookkeeper.

In 1842, and before he was of age, he entered into partnership in a general store with Mr. Albert Andrus, and in 1846 became sole proprietor. From that time until 1873, he continued in business as general merchant, grain and stock dealer; at one time having Governor Barry for a partner. Since 1873, and up to the present time, he has been farming, and stock, grain and wool buying.

His school education was obtained in the common schools of Salem, and later in Washington Academy before coming to Michigan. This and his training in the general store and counting house fitted him for his business career.

Mr. Wells has persistently refused legislative and other nominations offered him, but has continuously held positions of trust and responsibility. He was clerk of the township of Constantine at 21, has been member and president of village board of trustees; member of the school board for many years; member of the executive committee, and at one time elected president of the State Agricultural Society but refused to serve, chairman of its business committee, postmaster of Constantine under Lincoln and Harrison; and State statistical agent for the United States department of agriculture for four years.

March 29, 1894, was the 21st anniversary of Mr. Wells' appointment on the board and was made the occasion of a social gathering of the board and faculty of the college, all of whom deemed it a pleasure to thus honor the president of the board.

An elegant banquet was prepared and responses to toasts were made by Governor Rich, ex-Governor Jerome, Hon. Henry Chamberlain, Hon. C. W. Garfield, Dr. R. C. Kedzie, Pres. L. G. Gorton and K. L. Butterfield, editor of the Grange Visitor.

Mr. Wells has always insisted on keeping the work of the college in line with the plan outlined in the organic act creating the Board of Agriculture and establishing the college. His business training and knowledge of affairs have been of great aid in administering the affairs of the college.

In view of this long service and the entire devotion of Mr. Wells to the college and its interests, it seems not unfitting that a portrait and a short sketch, which are inserted without his knowledge, are entirely appropriate in this report as a tribute to his twenty-two years of unselfish labor for the Agricultural College.

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THIRTY-THIRD ANNUAL REPORT

OF THE

SECRETARY

OF THE

STATE BOARD OF AGRICULTURE

OF THE

STATE OF MICHIGAN

FROM

JULY 1, 1893, TO JUNE 30, 1894.

BY AUTHORITY.

LANSING:
ROBERT SMITH & CO., STATE PRINTERS AND BINDERS
1894

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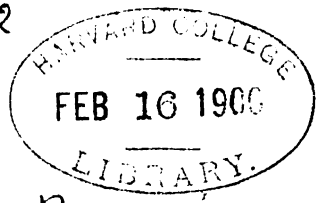

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REPORT OF THE SECRETARY

OF THE

STATE BOARD OF AGRICULTURE

AGRICULTURAL COLLEGE,
July 1, 1894.

To HON. JOHN T. RICH,

Governor of the State of Michigan:

SIR—I have the honor to submit to you herewith, as required by statute, the accompanying report for the fiscal year ending June 30, 1894, with supplementary papers.

Very respectfully,

IRA H. BUTTERFIELD,

Secretary of the State Board of Agriculture.

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STATE BOARD OF AGRICULTURE.

	Term expires.
HON. FRANKLIN WELLS, Constantine,	1895
PRESIDENT OF THE BOARD.	
HON. A. C. GLIDDEN, Paw Paw,	1895
HON. HENRY CHAMBERLAIN, Three Oaks,	1897
HON. EDWIN PHELPS, Pontiac,	1897
HON. CHAS. W. GARFIELD, Grand Rapids,	1899
HON. CHAS. F. MOORE, St. Clair,	1899
HON. JOHN T. RICH, GOVERNOR OF THE STATE,	*Ex officio.*
HON. LEWIS G. GORTON, M. S., PRES. OF THE COLLEGE,	*Ex officio.*

IRA H. BUTTERFIELD, AGRICULTURAL COLLEGE, SECRETARY.
BENJAMIN F. DAVIS, LANSING, TREASURER.

STANDING COMMITTEES.

The President of the Board is *ex officio* a member of each of the Standing Committees:

FINANCE,	C. W. Garfield, A. C. Glidden.
FARM MANAGEMENT,	C. F. Moore, E. Phelps.
BOTANY AND HORTICULTURE,	C. W. Garfield, E. Phelps.
BUILDINGS AND PROPERTY,	A. C. Glidden, C. F. Moore.
EMPLOYEES,	H. Chamberlain, A. C. Glidden, C. W. Garfield, L. G. Gorton.
FARMERS' INSTITUTES,	A. C. Glidden, C. W. Garfield, L. G. Gorton.
MECHANICS,	H. Chamberlain, C. W. Garfield.
VETERINARY DEP'T,	E. Phelps, C. F. Moore.
COLLEGE LAND GRANT,	C. F. Moore, H. Chamberlain.
MILITARY DEP'T,	C. W. Garfield, C. F. Moore.
STATE WEATHER SERVICE,	A. C. Glidden, C. W. Garfield.
EXPERIMENT STATION,	C. F. Moore, H. Chamberlain.

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AGRICULTURAL EXPERIMENT STATION.

OF THE

STATE AGRICULTURAL COLLEGE.

[Under control of the State Board of Agriculture.]

STATION COUNCIL.

L. G. GORTON, M. S., - - - - Director.

CLINTON D. SMITH, M. S. Agriculturist.
L. R. TAFT, M. S., - Horticulturist.
ROBT. C. KEDZIE, M. A., M. D., Chemist.
IRA H. BUTTERFIELD, - Sec. and Treas.

ADVISORY AND ASSISTANT STAFF.

F. B. MUMFORD, M. S., Asst. in Agriculture.
A. A. CROZIER, M. S., " Agriculture.
H. P. GLADDEN, B. S., " Horticulture.
*R. J. CORYELL, B. S., " Horticulture.
U. P. HEDRICK, B. S., " Horticulture.
W. L. ROSSMAN, B. S., " Chemistry.
H. E. HARRISON, B. S., " Chemistry.
E. A. A. GRANGE, V. S., - Veterinarian.
G. C. DAVIS, M. S., Consulting Zoölogist.
CHAS. F. WHEELER, B. S., " Botanist.
H. S. DUNNING, Asst. in Poultry Exp'ts.
H. M. HOWE, - Asst. to Director.
Mrs. L. E. LANDON, - - Librarian.

* Resigned June, 1894.

SUB-STATIONS.

Grayling, Crawford county, 80 acres deeded.
South Haven, Van Buren county, 10 acres rented; 5 acres deeded; Local Agent, T. T. Lyon, President State Horticultural Society.

STATE WEATHER SERVICE.

[Under control of the State Board of Agriculture.]

OFFICERS OF THE SERVICE.

DIRECTOR, - - - - - Edward A. Evans, U. S. Weather Service, Detroit.
ASSISTANT, - - - - - - E. H. Nimmo, Detroit.

STANDING COMMITTEE IN CHARGE.

HON. A. C. GLIDDEN, - - - - - - - - - - - Paw Paw.
HON. CHAS. W. GARFIELD, - - - - - - - - - - - Grand Rapids.

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STATE AGRICULTURAL COLLEGE.

[UNDER CONTROL OF THE STATE BOARD OF AGRICULTURE.]

FACULTY AND OTHER OFFICERS.

LEWIS G. GORTON, M. S., President; [a b c] Aug. 30, '93.

O. CLUTE, M. S., LL. D., President; [a] Feb. 25, 63; [b c] May 25, '89; [d] Aug. 30, '93.

ROBERT C. KEDZIE, M. A., M. D., Professor of Chemistry and Curator of the Chemical Laboratory; [a b c] Feb. 25, '63.

ALBERT J. COOK, M. S., Professor of Zoölogy and Entomology and Curator of the General Museum; [a b] Jan. 1, '67; [c] Nov. 10, '68; [d] Jan 1, '94.

WM. J. BEAL, M. A., Ph. D., Professor of Botany and Forestry and Curator of the Botanical Museum; [a b] July 9, '70; [c] Feb. 22, '71.

E. A. A. GRANGE, V. S., Professor of Veterinary Science; [a b c] May 22, '83.

LEVI R. TAFT, M. S., Professor of Horticulture and Landscape Gardening, and Superintendent of the Horticultural Department, [a b c] Aug. 1, '88.

HOWARD EDWARDS. M. A., LL. D., Professor of English Literature and Modern Languages; [a b c] Aug. 25, '90.

LESTER P. BRECKENRIDGE, Ph. B., Professor of Mechanical Engineering and Director of the Shops; [a b c] Aug. 24, '91, [d] Aug. 30, '93.

HERMAN K. VEDDER, C. E., Professor of Mathematics and Civil Engineering; [a b c] Sept. 15, '91.

P. MIRICK HARWOOD, B. S., Professor of Practical Agriculture and Superintendent of the Farm; [a b c] Feb. 1, '92; [d] Aug. 30, '93.

EDSON A. LEWIS, 2d Lieut. 18th Infantry, U. S. Army, Professor of Military Science and Tactics; [a b c] June 20, '92.

IRA H. BUTTERFIELD, Secretary; [a b c] July 1, '93.

CLINTON D. SMITH, M. S., Professor of Practical Agriculture and Superintendent of the Farm; [a b c] Sept. 1, '93.

CHAS. L. WEIL, S. B., Professor of Mechanical Engineering and Director of the Mechanical Department; [a b c] Sept. 1, '93.

WALTER B. BARROWS, S. B., Professor of Zoölogy and Physiology, and Curator of the General Museum; [a b c] Feb. 15, '94.

FRANK S. KEDZIE, M. S., Adjunct Professor of Chemistry; [a b] Sept. 15, '80; [c] Jan. 1, '91.

PHILIP B. WOODWORTH, B. S., M. E., Assistant Professor of Physics; [a b] May 22, '87; [c] Aug 7, '89.

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ALVIN B. NOBLE, Ph. B., Assistant Professor of English Literature and Modern Languages; [a b c] Sept. 1, '89.
WILLIAM S. HOLDSWORTH, B. S., Assistant Professor of Drawing; [a] Feb. 22, '81; [b] Aug. 22, '87; [c] Jan. 1, '90.
FRED W. MCNAIR, B. S., Assistant Professor of Mathematics; [a b c] Jan. 1, '92; [d] Aug. 30, '93.
FRED B. MUMFORD, M. S., Assistant Professor of Agriculture; [a b c] June 1, '93.
WILBUR O. HEDRICK, B. S., Assistant Professor of History and Political Economy; [a b] Aug. 24, '91; [c] Sept. 1, '93.
PAUL M. CHAMBERLAIN, M. E., Assistant Professor of Mechanical Engineering; [a b c] Sept. 1, '93.
WARREN BABCOCK, JR., B. S., Assistant Professor of Mathematics; [a b] June 30, '91; [b] Sept. 1, '93.
GILBERT H. HICKS, B. S., Instructor in Botany; [a b c] June 6, '91; [d] Jan. 20, '94.
MRS. LINDA E. LANDON, Librarian; [a b c] Aug. 24, '91.
GEORGE A. GOODENOUGH, B. S., Instructor in Mechanics; [a b c] Aug. 24, '91; [d] May 20, '93.
GAGER C. DAVIS, M. S., Instructor in Zoölogy; [a b c] Mar. 1, '93.
CHARLES F. WHEELER, B. S., Instructor in Botany; [a b] Mar. 1, '90; [c] May 1, '93.
A. L. WESTCOTT, B. M. E., Instructor in Mechanical Engineering; [a b c] June 1, '93.
DICK J. CROSBY, B. S., Instructor in English; [a b c] Sept. 1, '93.
J. N. HATCH, B. S., Instructor in Mathematics; [a b c] Sept. 1, '93.
ALVA T. STEVENS, B. S., Instructor in Agriculture; [a b c] Feb. 1, '94.
BURTON O. LONGYEAR, Instructor in Botany; [a b c] Feb. 15, '94.
E. A. EDGERTON, Engineer; [a b c] Mar. 25, '91.
WILLIAM H. VANDERVOORT, B. S., Foreman of the Iron Shops; [a b c] Nov. 1, '89; [d] Aug. 30, '93.
ALFRED G. GULLEY, M. S., Foreman of the Horticultural Department; [a b c] Mar. 1, '90; [d] Oct. 9, '93.
ALBERT R. CURTISS, Foreman of the Wood Shops; [a b c] Aug. 25, '90; [d] Aug. 30, '93.
THOMAS GUNSON, Foreman of Greenhouse; [a b] April 1, '91; [c] Sept. 1, '91.
WALTER D. GROESBECK, B. S., Foreman of the Machine Shop; [a b] April 1, '91; [c] Feb. 1, '93.
OSCAR CLUTE, Assistant Secretary; [a b c] Feb. 1, '93; [d] Sept. 1, '93.
ROSCOE C. BRADLEY, Assistant Secretary; [a b c] Sept. 1, '93.
CHACE NEWMAN, Clerk in Mechanical Department; [a b c] Dec. 1, '92.
ERNST WITTSTOCK, Foreman of the Farm; [a b c] Feb. 2, '93.
FRANK BENDER, Foreman of the Wood Shops; [a b c] Sept. 8, '93.
THOMAS DURKIN, Foreman of the Horticultural Department; [a b c] Mar. 15, '94.

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[a] First appointment.
[b] Present appointment.
[c] Present title.
[d] Resignation.
[e] Transferred to experiment station staff.

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ACCOUNTS OF THE STATE AGRICULTURAL COLLEGE.

FOR THE FISCAL YEAR ENDING JUNE 30, 1894.

SECRETARY'S ACCOUNT.

				Dr.	Cr.
July	1, 1893.	To cash on hand		$3,087 73	
"	1, 1893.	To cash on deposit with college treasurer, less $1,927.46 outstanding warrants		17,813 26	
"	1, 1893.	By balance due students on deposit accounts			$3,159 90
"	1, 1893.	To cash on deposit with New York bank		365 98	
June	30, 1894.	To special appropriation receipts, per No. table 2, page 10:			
		From State Treasurer	$12,300 00		
		From United States Treasurer	15,000 00		
		From institution	2,272 04		
				29,572 04	
June	30, 1894.	By special appropriation disbursements, per page 10			26,734 21
"	30, 1894.	To current account receipts, per table No. 3, page 11:			
		From State Treasurer	$34,120 58		
		From United States Treasurer	19,000 00		
		From institution	8,275 02		
		From institution on building account	4,226 53		
				65,622 13	
June	30, 1894.	By current account disbursements, per table No. 3, page 11:			
		General current account	$66,802 98		
		Current building account	467 30		
					67,270 28
June	30, 1894.	To balance due students on deposits		3,339 33	
"	30, 1894.	By cash on deposit with college treasurer, less $2,888.06 outstanding warrants			9,198 17
"	30, 1894.	By cash on deposit with New York bank			533 85
"	30, 1894.	By cash on hand			2,894 06
				$119,790 47	$119,790 47

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TABLE No. 1.—*Tabular exhibit of Secretary's account.*

Name of account.	Balance sheet, July 1, 1893.		Transactions July 1, 1893, to June 30, 1894.		Balance sheet, June 30, 1894.	
	Dr.	Cr.	Dr.	Cr.	Dr.	Cr.
Cash	$3,453 71			*$25 80	$3,427 91	
College treasurer	17,813 26			*8,615 09	†9,198 17	
Students' deposits		$3,159 90		*169 43		$3,329 33
Special appropriations		10,816 27	$36,784 21	29,572 04		3,654 10
Current building account	3,664 40		457 30	4,226 53		94 83
Current general account		10,955 20	66,802 98	61,395 60		5,547 82
Totals	$24,931 37	$24,931 37	$104,004 49	$104,004 49	$12,626 08	$12,626 08

* Balance of Dr. and Cr. transactions.
† Treasurer's statement is greater July 1, 1893, by $1,927.46, and June 30, 1894, by $2,888.06 warrants outstanding.

TREASURER'S ACCOUNT.

	Dr.	Cr.
Balance July 1, 1893	$19,740 72	
Receipts from State Treasurer and Secretary of State Board of Agriculture	98,771 86	
Interest on deposits, 12 months, at 3 per cent	523 80	
Warrants paid from July 1, 1893, to June 30, 1894		$106,950 15
Balance on hand June 30, 1894		12,086 23
	$119,036 38	$119,036 38

B. F. DAVIS, *Treasurer.*

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TABLE No. 2.—*Statement of special appropriation account for fiscal year July 1, 1893, to June 30, 1894.*

Name of appropriation.	Balance of account, July 1, 1893.		Receipts during fiscal year.		Total available.	Total expended.	Balance of account, June 30, 1894.		Total appropriation for 1893-4.	Balance of appropriation in State Treasury, June 30, 1894.
	Dr.	Cr.	From State Treasurer.	From institution.			Dr.	Cr.		
Horticultural department		$4 49			$4 49	$4 49				
Repair of buildings, steam, and water works		4,671 31	$1,000 00	$379 67	6,050 98	6,071 00	$20 02		$10,000 00	$4,000 00
Student labor (see table No. 9, page 14)		2,914 43			2,914 43	3,215 29	300 86		8,000 00	4,000 00
Garden team		200 00			200 00	200 00			200 00	
Farm team		200 00			200 00	200 00			200 00	
Farm fencing		200 00			200 00	113 99		$86 01	200 00	
Equipping botanical laboratory		841 54		25 00	866 54	862 21		4 33	1,000 00	
Blacksmith shop and foundry		1,500 00			1,500 00	1,500 00			1,500 00	
Addition to horticultural dwelling		500 00			500 00	499 07		93	500 00	
Wells hall privy		291 00			291 00	291 00			300 00	
Experiment station (see table No. 4, page 11)	$495 25		* 15,000 00	1,844 57	16,349 33	14,646 82		1,702 50	30,000 00	
Farmers' institutes	1,000 00		2,500 00		1,500 00	768 59		731 41	4,000 00	1,500 00
Drainage			200 00		200 00	304 49	104 49		500 00	300 00
Equipping agricultural laboratory						15 00	15 00		500 00	500 00
Walks and roads			3,500 00		3,500 00	3,500 00			3,500 00	
Hospital			2,500 00		2,500 00	1,298 41		1,201 59	2,500 00	
Sewerage			1,000 00		1,000 00	975 90		24 10	1,000 00	
Library gallery			800 00		800 00	629 01		170 99	800 00	
Mechanical department			500 00		500 00	496 81		3 19	500 00	
Museum cases									225 00	225 00
Additional sheds			800 00		800 00	54 69		245 31	800 00	
Library		988 75		22 80	1,011 55	1,087 44	75 89		2,000 00	1,000 00
Balances	10,816 27						3,654 10			
Totals	$12,311 52	$12,311 52	$27,300 00	$2,272 04	$40,388 31	$36,734 21	$4,170 86	$4,170 86	$67,725 00	$11,525 00

* $15,000 from U. S. treasury.

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TABLE NO. 3.—*Current account July 1, 1893, to June 30, 1894.*

On account of—	Dr. To disbursements.	Cr. By receipts.
United States Treasurer, fifth annual payment under act of congress of August 30, 1890		$19,000 00
State Treasurer, interest on proceeds of sales of U. S. land grant, see table No. 13, page 18		4,120 58
Students' class fees, per table No. 8		3,428 89
Students' sundry fees, credited to building account, per table No. 8		3,245 79
Salaries paid	$33,814 40	
Farm department, see table No. 6, page 18	5,652 63	2,667 31
Horticultural department, see table No. 7, page 18	3,866 98	1,273 94
Mechanical department	3,797 84	85 51
Heating, lighting and cleaning	9,639 07	590 88
Academic departments	5,904 92	56 19
Offices, postage, stationery, advertising and sundry	4,127 64	172 80
State swamp land grant sale, credited to building account		438 59
Interest and exchange, credited to building account		547 15
Building account	467 80	
Totals	$67,270 28	$65,622 13
Balance at beginning of period, July 1, 1893		7,290 80
Balance at close of period, June 30, 1894	5,642 65	
Footings	$72,912 93	$72,912 93

TABLE NO. 4.—*Experiment station account, July 1, 1893 to June 30, 1894.**

On account of—	Dr. To disbursements.	Cr. By receipts.
Balance from last fiscal year	$495 25	
U. S. treasurer for fiscal year		$15,000 00
Fertilizer license fees and expenses	75 00	1,160 00
Salaries	7,383 66	
Farm department	1,659 71	657 57
Horticultural department	545 77	
Chemical department	228 14	
Botanical department	13 70	
Zoölogical department	122 40	
Veterinary department	65 60	
Buildings	746 15	
Library	604 72	
Weather service	1 90	
Offices, etc.	226 58	
Grayling Station	430 36	27 60
South Haven Station	2,007 80	
Apiary	507 75	
Poultry department	28 08	
Balance on hand at close of fiscal year	1,702 50	
Totals	$16,844 57	$16,844 57

* For fuller details of this account see the special report of the experiment station in the body of this volume.

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TABLE No. 5.—*Employés and salaries.*

	Paid from.			Total.
	Current account.	Experiment station account.	Other sources.	
President, dwelling and	$2,700 00	$500 00		$3,200 00
One professor, dwelling and	1,700 00	300 00		2,000 00
Two professors, dwelling and $1,800 each	2,400 00	1,200 00		3,600 00
Five professors, dwelling and $1,800 each	9,000 00			9,000 00
One professor	1,800 00			1,800 00
*One professor, dwelling and			$1,800 00	1,800 00
One professor	1,200 00	300 00		1,500 00
Five assistant professors, rooms and $1,000 each	5,000 00			5,000 00
One assistant professor, rooms and $1,000	500 00	500 00		1,000 00
One assistant professor, rooms and	900 00			900 00
One instructor, rooms and	700 00			700 00
One instructor	600 00			600 00
Three instructors, rooms and $500 each	1,500 00			1,500 00
†Secretary, dwelling and	300 00	500 00	1,000 00	1,800 00
Assistant secretary, room and	600 00			600 00
Librarian, rooms and	505 00	120 00		625 00
Foreman of farm, dwelling, board and	600 00			600 00
Foreman of garden, rooms and	650 00			650 00
Foreman of iron shop, room and	500 00			500 00
Foreman of wood shop	750 00			750 00
Florist, dwelling and	800 00			800 00
One assistant florist, rooms and	420 00			420 00
One consulting botanist, rooms and	500 00	500 00		1,000 00
One consulting entomologist, room and	500 00	500 00		1,000 00
Four assistants in experiments, rooms and $500 each		2,000 00		2,000 00
One assistant in experiments, room and		700 00		700 00
One assistant in experiments, room and		300 00		300 00
One assistant in experiments, rooms and		1,000 00		1,000 00
Engineer, dwelling and	600 00			600 00
Fireman	420 00			420 00
Herdsman, room, board and	420 00			420 00
Janitor, rooms and	$12 00			312 00
One clerk in mechanical department, room and	420 00			420 00
Totals	$36,297 00	$8,420 00	$2,800 00	‡ $47,517 00

* Army officer detailed as Professor of Military Science and Tactics. Salary paid by U. S. Government.
† $1,000 of salary as Secretary of the Board of Agriculture is paid from the State treasury.
‡ This total represents the rate of salaries and not the amount actually paid out.

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TABLE No. 6.—*Account with Farm Department.*

On account of—	Dr. To disbursements.	Cr. By receipts.
Labor aside from student labor	$2,127 88	
Farm house	17 42	
Cattle	607 31	$1,206 86
Sheep	142 46	86 11
Swine	116 78	283 07
Grain	84 17	
Produce		298 52
Implements and repairs	250 74	
Wood		210 81
Office, etc.	417 14	103 05
Drains	1 40	
Seeds	129 48	
Board of farm hands	766 81	
Team	224 13	84 28
Dairy	817 01	395 61
Balance		2,985 82
Footings	$5,652 63	$5,652 63

TABLE No. 7.—*Account with Horticultural Department, including greenhouse.*

On account of—	Dr. To disbursements.	Cr. By receipts.
Labor, aside from student labor	$2,561 71	
Team	468 48	
Grounds	163 51	
Freight	65 33	
Implements and repairs	251 05	
Seeds and plants	133 83	
Ice	26 88	
Office, etc.	191 19	
Sundry receipts		$1,033 24
Greenhouse receipts		241 70
Balance		2,593 04
Footings	$3,866 98	$3,866 98

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TABLE No. 8.—*Students' fees.*

On account of—	Current account, general.	Current account, building.	Total.
Room rent	$1,065 38	$1,994 79	$3,060 17
Incidental expense fee	1,873 75		1,873 75
Physiological dissection fee	17 50		17 50
Veterinary dissection fee	50		50
Chemical analysis fee	435 97		435 97
Damages	1 00		1 00
Special examination fee		81 00	81 00
Matriculation fee		630 00	630 00
Diploma fee		220 00	220 00
Tuition fee from non-resident students		320 00	320 00
Physical fee	34 79		34 79
Totals	$3,428 39	$3,245 79	$6,674 68

TABLE No. 9.—*Student Labor.—Account of wages paid for twelve months, July 1, 1893, to June 30, 1894.*

On account of—	Student labor.	Experiment station.	Total.
Farm department	$1,219 91	$5 34	$1,225 25
Horticultural department	1,232 64		1,232 64
Mechanical department, repairs and heating	110 60		110 60
Bell ringing, choir, etc.	83 80		83 80
Janitor	179 30		179 30
Offices	17 36		17 36
Veterinary department	10 40		10 40
Zoological department	44 88		44 88
Botanical department	92 08		92 08
Physical department	39 96		39 96
Drafting department	5 04		5 04
Military department	79 58		79 58
Library	41 96		41 96
Engineering department	2 44		2 44
Totals	$3,209 95	$5 34	$3,215 29

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TABLE No. 10.—*Agricultural College lands, United States grant of 1862, record of sales and forfeitures to the present time.*

Year.	Original sales.			Forfeited lands resold.			Total sales.			Number of acres reverting by forfeiture.	Aggregate of sales, less forfeitures to end of each year. Acres.	Balance remaining vacant at end of each year. Acres.
	Acres.	Average price per acre.	Amount.	Acres.	Average price per acre.	Amount.	Acres.	Average price per acre.	Amount.			
1867												235,683.46
1868	520.	$5 00	$2,600 00				520.	$5 00	$2,600 00		520.	235,163.46
1869	13,480.	3 19	43,000 00				13,480.	3 19	43,000 00		14,000.	221,683.46
1870	3,280.	3 44	11,280 00				3,280.00	3 44	11,280 00		17,280.	218,403.46
1871	9,372.44	3 37	31,687 32				9,372.44	3 37	31,687 32		26,652.44	209,030.02
1872	20,580.25	3 19	65,660 75				20,580.25	3 19	65,660 75		47,232.69	188,449.77
1873	17,205.89	3 15	54,177 67	40.	$3 62	$145 00	17,245.89	3 15	54,322 67	40.	64,438 58	171,243.88
1874	2,089.95	3 20	6,519 75	40.	3 00	120 00	2,079.95	3 19	6,639 75	688.72	65,879.81	169,802.65
1875	4,798.99	3 08	14,796 97	40.	3 00	120 00	4,838.99	3 08	14,916 97	560.	70,158.80	165,523.66
1876	1,963.73	3 12	6,101 19	520.	4 38	2,280 00	2,473.73	3 39	8,381 19	1,758.40	70,874.13	164,808.33
1877	1,634.75	3 00	4,904 25	200.	3 00	600 00	1,834.75	3 00	5,504 25	1,436.06	71,270.82	164,411.64
1878	4,084.80	3 10	12,504 40	1,135.73	3 91	4,443 65	5,170.53	3 28	16,948 05	2,415.73	74,025.62	161,656.84
1879	6,732.12	3 02	20,506 36	1,318.06	3 06	4,054 18	8,100.18	3 03	24,560 54	1,978.11	80,147.69	155,534.77
1880	8,826.56	3 03	26,729 58	280.	3 18	890 00	9,106.56	3 08	27,619 58	4,926.83	84,327.93	151,354.54
1881	6,168.97	3 96	24,447 25	360.	4 33	1,560 00	6,528.97	3 98	26,007 25	1,967.19	88,869.70	146,812.76
1882	10,225.99	5 00	51,129 95	1,637.01	5 09	8,335 05	11,863.	5 01	59,465 00	760.11	99,972.59	135,709.87
1883	7,035.57	5 00	35,177 85	1,680.	5 08	8,448 00	8,715.57	5 00	43,625 85	560.	108,128.16	127,554.30
1884	1,846.01	5 09	9,390 05	526.45	5 38	2,832 25	2,372.46	5 15	12,222 30	200.	110,300.62	125,381.84
1885	704.88	5 74	4,044 40	119.52	5 67	677 60	824.40	5 73	4,722 00	525.47	110,599.55	125,082.91
1886	720.00	5 83	4,200 00	560.	5 78	3,240 00	1,280.00	5 81	7,440 00	440.	111,439.55	124,242.91
1887	1,718.27	6 45	11,091 35	320.	5 00	1,600 00	2,038.27	6 23	12,691 35	200.	113,277.32	122,404.64
1888	2,031.18	6 02	12,235 90	160.	5 00	800 00	2,191.18	5 95	13,035 90	640.	114,829.00	120,853.46
1889	1,000.28	6 64	6,641 40	40.	5 00	200 00	1,040.28	6 58	6,841 40	120.	115,749.28	* 119,585.86
1890	2,674.70	8 06	21,561 88				2,674.70	8 06	21,561 88	480.	117,943.98	117,391.16
1891	2,614.66	8 26	21,593 02	480.	6 47	3,105 00	3,094.66	7 98	24,698 02	920.	120,118.64	115,216.50
1892										480.	119,638.64	† 115,996.55½
1893	13,376.04	7 47	100,960 99	1,605.95	8 58	10,494 75	14,981.99	7 44	111,455 74	360.	133,014.68	102,590.51½
1894	40.	12 50	500 00				40.	12 50	500 00	440.	132,614.68	102,990.51½
Totals.	144,656.03	$4 48	$803,392 28	11,062.72	$4 87	$53,945 48	155,728.75	$4 53	$857,337 76	21,868.12		

* This amount is 347.32 less than it should be; as to which see p. 19 of report for 1889.
† This amount is 200.055 more than accords with the report of 1891; as to which see p. 15 of this volume.

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TABLE No. 11.—*Agricultural College lands, United States Grant of 1862: Record of forfeitures by counties during the fiscal year ending June 30, 1894, and of the number of acres vacant at the beginning and end of the year.*

Counties.	Acres vacant June 30, 1893, as reported by the land office.	Acres revert'g by forfeit're during the fiscal year ending June 30, 1894.	Sales during 1894.	Acres vacant June 30, 1894, if columns 1, 2 and 3 are correct.	Acres vacant June 30, 1894, as reported by the land office.	Discrepancy between columns 4 and 5.		Discrepancy noted on page 19, of the agricultural report of 1893.		Total net discrepancy from reports of land office prior to 1879.	
						Shortage.	Excess.	Shortage.	Excess.	Shortage.	Excess.
Alcona	18,525.71			18,525.71	18,525.71			227.92		40.	
Alpena	1,000			1,000.00	1,000.00						
Antrim	2,400.93	80.		2,480.93	2,520.93		40.				
Benzie	3,360.			3,360.00	3,360.00			80.			
Charlevoix	2,149.54			2,149.54	2,159.54		10.				
Cheboygan	5,085.96			5,085.96	5,079.81	6.15					
Grand Traverse	160.			160.00	160.00						
Iosco	26,322.27			26,322.27	26,322.27						
Kalkaska	1,158.	120.		1,278.00	1,158.00	120.		40.		120.	
Manistee	5,277.255	40.		5,317.255	5,357.235		39.98				3.99⅓
Missaukee	879.64			879.64	879.64						
Montmorency	6,489.50			6,489.50	6,529.50		40.	40.		40.	
Oscoda	13,370.22			13,370.22	13,370.22				80.60		83.28
Otsego	1,163.14			1,163.14	1,163.14						
Presque Isle	400.			400.00	400.00						106.46
Wexford	13,167.82	200.	40.00	13,327.82	13,508.02		180.20	40.		40.	
Totals	100,909.985	440.00	40.00	101,309.985	101,494.015	126.15	310.18	427.92	80.60	240.	192.73⅓

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TABLE No. 12.—*Agricultural College trust fund.*

Year.	Receipts of State Land Office on account of principal for Agricultural College lands sold.	Refunded on account of erroneous payments.	Balance transferred to credit of Agricultural College trust funds.	Aggregate to credit of Agricultural College trust fund at close of each fiscal year.
1868	$2,300 00		$2,300 00	$2,300 00
1869	11,865 00		11,865 00	14,165 00
1870	5,895 00		5,895 00	20,060 00
1871	20,101 53		20,101 53	40,161 53
1872	33,621 93	$174 54	33,447 39	73,608 92
1873	29,583 47		29,583 47	103,192 39
1874	4,686 75		4,686 75	107,979 14
1875	5,299 24		5,299 24	113,278 38
1876	5,989 30	390 00	5,549 30	118,827 68
1877	2,337 22		2,337 22	121,164 90
1878	9,619 99		9,619 99	130,784 89
1879	8,590 53		8,590 53	139,375 42
1880	13,762 28		13,762 28	153,137 70
1881	20,281 18	60 00	20,281 18	173,418 88
1882	51,449 27		51,449 27	224,868 15
1883	34,482 28	825 90	33,656 38	258,524 53
1884	13,902 87		13,902 87	272,327 40
1885	12,460 87		12,460 87	284,788 27
1886	16,545 31		16,545 31	301,333 58
1887	26,731 62		26,731 62	328,065 20
1888	18,122 35		18,122 35	346,187 55
1889	11,431 65		11,431 65	357,619 20
1890	15,991 64		15,991 64	373,610 84
1891	21,992 89		21,992 89	395,605 73
1892	5,628 90	180 00	5,628 90	401,234 63
1893	120,468 27		120,468 27	521,702 90
1894	4,235 08		4,235 08	525,937 98

NOTE.—Fifteen thousand dollars of the above fund was invested from 1870 to 1871 in war bounty bonds and held by the College.

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TABLE No. 13.—*Agricultural College interest fund.*

Year.	Interest on Agricultural College fund at 7 per cent, paid by State Treasurer from specific tax fund.	Interest from purchasers on balances due on certificates for part-paid land, less refundings and expenses for appraisals, etc.†	Receipts for penalty.	Trespass collections.	Total accrued to credit of Agricultural College each year.	Amount paid over to treasurer of Agricultural College.	Balance remaining to credit of Agricultural College interest fund at close of each fiscal year.
1869	----------	$56 68	$2 28	----------	$58 96	----------	$58 96
1870	* $874 95	1,789 56	56 42	----------	2,720 93	$2,779 89	----------
1871	§ 1,397 97	2,317 24	70 63	----------	3,785 84	2,976 00	809 84
1872	3,953 17	3,099 51	122 97	----------	7,175 65	6,774 47	1,211 02
1873	6,040 33	4,907 77	110 96	----------	11,059 06	12,238 48	31 60
1874	7,407 65	6,499 21	155 12	----------	14,061 98	11,896 00	2,197 58
1875	7,717 24	6,552 93	125 97	$50 00	14,446 14	14,656 00	1,987 72
1876	8,124 31	6,692 47	306 64	1,706 75	16,830 17	18,817 89	----------
1877	8,396 64	5,726 58	189 64	860 00	15,172 86	15,172 86	----------
1878	8,740 62	6,405 26	247 21	414 00	15,807 09	13,320 61	2,486 48
1879	9,409 78	6,864 80	276 55	627 14	16,978 22	16,602 02	2,862 68
1880	10,240 28	7,383 23	148 73	115 00	17,887 24	17,799 15	2,900 77
1881	11,426 93	8,642 08	285 47	580 77	20,985 25	20,451 85	3,334 17
1882	13,957 04	8,345 45	204 96	----------	22,507 45	25,891 62	----------
1883	16,741 38	9,141 30	206 96	4,659 96	30,749 60	26,139 13	4,610 47
1884	18,739 02	8,881 98	237 56	51 16	27,909 72	27,402 94	5,117 25
1885	19,645 33	9,121 14	329 06	674 87	29,770 40	29,599 97	5,287 68
1886	20,571 55	9,323 98	565 41	----------	30,461 04	29,920 68	5,828 04
1887‡	16,493 96	7,577 57	209 84	229 98	24,611 37	19,761 06	10,678 35
1888	23,425 64	7,310 84	394 85	1,275 27	32,496 60	32,006 10	11,078 85
1889	24,551 32	6,326 29	320 23	124 75	31,322 69	31,888 12	10,513 42
1890	25,653 31	6,490 27	387 25	20 00	32,360 64	32,228 79	10,645 27
1891	27,197 59	6,690 99	348 22	513 44	34,750 54	26,516 92	18,878 89
1892	27,693 14	6,639 20	316 78	100 00	34,948 12	26,153 78	27,673 23
1893	31,484 01	6,107 32	315 71	40 00	37,927 04	51,600 24	13,999 93
1894	36,657 47	5,638 31	365 08	1,866 40	44,527 26	34,120 58	24,406 61

* This amount was interest on war bounty bonds in which the fund was invested at the time.

§ $525 of this was interest on war bounty bonds in which the fund was invested part of the year.

† Appraisal expenses amounted to $1,726.32, ranging from nothing in 1872 to $208.94 in 1886. Advertising amounted to $1,205.20, ranging from nothing in 1870 to $218.85 in 1884. Trespass examination amounted to $4.00 in 1883.

‡ Nine months.

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SUMMARY OF INVENTORY, JUNE 30, 1894.

College farm and park, 676 acres @ $70			$47,320 00
Buildings—			
Library and museum, built 1881	$25,000 00		
College hall, " 1856	20,000 00		
Williams " " 1869	40,000 00		
Wells " " 1877	25,000 00		
Abbot " " 1888	13,000 00		
Chemical laboratory, " 1871 south end added '81	18,000 00		
Machine shops and foundry, 1885 south end added '87	12,300 00		
Veterinary laboratory, built 1885	5,400 00		
Horticultural " " 1888	6,000 00		
Agricultural " " 1889	8,000 00		
Botanical " " 1892	10,000 00		
Armory, " 1885	6,000 00		
Greenhouse and stable, " 1873, 1879; rebuilt 1892	6,331 55		
Greenhouse, experiment, " 1889	1,500 00		
Boiler house and chimney 1893–4	5,000 00		
President's and two frame dwellings, built 1874	15,000 00		
Four brick dwellings, built 1857	12,500 00		
Station apartment dwellings, built 1892	3,500 00		
Two brick " " 1879 and 1884	7,000 00		
One frame dwelling " 1885	4,000 00		
Howard terrace " " 1888	14,500 00		
Farm house " " 1869	3,500 00		
Herdsman's " " 1867	400 00		
Ten barns at professors' houses	2,500 00		
Horticultural barn and shed, " 1868, 1875, 1887	1,500 00		
Cattle barn and shed, " 1862	3,500 00		
Sheep " " 1865	2,000 00		
Horse " " 1871	2,500 00		
Pig " " 1871	2,000 00		
Corn " " 1878	500 00		
Grain " " 1881	1,600 00		
Tool " " 1881	1,300 00		
Feed " " 1884	1,200 00		
Brick work shop, " 1857	600 00		
Observatory, " 1880	150 00		
Bath house and fittings, " 1889	600 00		
Ice house, 1879, $100.00; feed mill 1889, $100.00	200 00		
Bee houses, 1874, $50.00; 1887, $700.00	750 00		
Hospital, 1894 (incomplete)	1,300 00		
Poultry building, 1894	500 00		284,631 55
Iron bridge over Cedar river, built 1888			1,000 00
Water works and steam works—			
Artesian well and connections, sunk in 1887, 343 ft. deep	$1,000 00		
Fire pump, 1883, $675.00; tank pump, 1881, $180.00	855 00		
700 feet fire hose, 2½ in., bought 1883–88	320 00		
Two hose carts and 4 nozzles, bought 1883–88	75 00		
2,378 ft. wood pipe, 6 in., laid 1883–87	900 00		
2,623 " " " 4 " " 1883–87	720 00		
662 " " " 3 " " 1883–87	135 00		
Water tank and heater, built 1883	520 00		
13 fire hydrants in place, built 1883–87	475 00		
Valves, fittings and connections, laid 1883–87	725 00		
Four boilers, 4 ft. x 12 ft., built 1881	1,180 00		
Two boilers, 5 ft. x 12 ft., built 1887	1,310 00		
Two small pumps, 1884–91	310 00		
Underground steam piping, laid 1882	1,600 00		
Miscellaneous tools and stock	820 69		
Ten fire extinguishers	300 00		
One water purifier	418 00		
Water meter	25 00		
Injector	22 00		
Main steam pipe, 1892	160 00		11,870 69
Carried forward			$344,822 24

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INVENTORY — *Continued.*

Brought forward		$344,822 24
Farm department—		
Cattle, 52 head	$3,020 00	
Horses, 8 "	1,150 00	
Sheep, 87 "	1,235 00	
Swine, 26 "	162 00	
Class room, office and farm house equipment	2,620 34	
Tools, implements, scales, windmills, etc.	3,907 20	
Experiment station	1,193 10	
Growing crops, estimated	1,555 00	
		14,842 64
Horticultural department—		
Teams, harness, etc.	$486 00	
Heavy tools	553 70	
Compost and manure	150 00	
Small tools	81 05	
Students' tools	306 85	
Office and other rooms	181 00	
Class room	1,053 50	
Vegetable garden	154 50	
Greenhouse plants	2,826 30	
Miscellaneous	545 95	
Experiment station	1,120 80	
		7,459 65
Mechanical department—		
Class room and office equipment	$3,601 35	
Machine shop	9,514 73	
Wood shop	2,336 06	
Blacksmith shop and foundry	1,416 78	
		16,868 92
Chemical department—		
Furniture, apparatus and chemicals	$9,154 34	
Experiment station	1,987 02	
		11,141 36
Physical department—		
Light	$1,610 99	
Electricity	3,294 05	
Sound	296 10	
Mechanics and fixtures	2,019 10	
		7,220 24
Botanical department—		
Herbarium	$3,658 87	
Museum	880 75	
Office and class apparatus	2,661 20	
Experiment station	450 76	
		7,651 58
Mathematical and engineering department—		
Surveying instruments	$1,579 75	
Telescope and accessories	841 75	
Furniture, apparatus, etc.	901 80	
Photographic material	63 05	
		3,386 35
Library, inclusive of experiment station library—		
17,521 books and 3,114 pamphlets	$35,427 00	
Furniture	1,909 74	
		37,336 74
Veterinary laboratory—Museum, furniture and apparatus		2,326 20
Zoological department—Furniture and apparatus		1,720 75
General museum—Collections and cases		16,534 00
Apiary, bees, stock, etc., including experiment station items		162 86
College hall furniture and English department		1,157 83
Drawing		680 03
Photographic apparatus and material		266 00
Public parlor furniture, $191.86; hospital furniture, $20.75		212 61
Club Boarding Association, 15 shares stock		300 00
President's office		712 45
Secretary's office		1,142 00
Weather service		1,968 70
Armory, furniture and equipment		801 25
		$478,714 40

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U. S. property held in trust:		
Two 3 in. rifled guns and equipments	$1,573 55	
150 Springfield rifles, complete	2,250 00	
150 rifle equipments	399 00	
Reloading tools, chests, tarpaulins, etc.	183 69	
		$4,406 24

SUMMARY OF EXPERIMENT STATION INVENTORY.

Included in the above total of $478,714.40 is $21,894.89 which belongs to the experiment station consisting of the following items:

Lands donated to the station—		
80 acres at Grayling, fenced and improved at cost	$1,850 00	
5 acres at South Haven, fenced and improved	1,000 00	
		$2,850 00
Buildings—		
Experiment feed barn	$1,200 00	
Horticultural laboratory, experimental rooms	1,200 00	
Veterinary laboratory, experimental rooms	250 00	
Apiary	600 00	
Forcing house	1,500 00	
Feed mill	100 00	
Sub-faculty building	3,500 00	
Seed room	980 00	
Poultry house and yards	450 00	
Dairy room in agricultural laboratory	250 00	
		10,030 00
Library and offices of director and secretary—		
1,146 books	$2,292 00	
Files, cards, cases, etc.	49 10	
Furniture, etc.	75 00	
One mailing list in type	300 00	
		2,716 10
Farm department—		
1 pair geldings	$150 00	
Office equipment	529 80	
Tools	513 30	
		1,193 10
Horticultural department—		
One horse	$100 00	
Office, furniture, implements, etc.	1,020 80	
		1,120 80
Chemical department—		
Thermometers, $154.20; balances, $550.45; platinum, $250.85; sundry apparatus, $1,031.52		1,987 02
Botanical department—		
Microscopes and accessories	$320 25	
Furniture and sundry apparatus	130 51	
		450 76
Veterinary department—		
Instruments and sundry apparatus		725 00
Zoölogical department—		
Microscopes, cases, etc.		659 25
Apiary—		
Bees, stock and tools		162 86
		$21,894 89

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TABLE No. 16.—*Detailed statement of Legislative appropriations to the State Agricultural College.*

Object.	Total.	1893.	1891.	1889.	1887.	1885.	1883.	1881.	1879.	1877.	1875.	1873.	1855–71.
Buildings		Equip. botanical lab. $1,000 Foundry 1,500 Hospital 2,500	Botanical lab't'y ..... $10,000 Heating apparatus .. 1,950 Greenhouse 4,500	Agricultural lab't'y ..... $8,000 Sundry 1,800	Howard terrace ..... $10,000 Abbot hall ..... 10,000 Horticultural lab't'y. 5,000 Mechanical lab't'y. 3,000 Bridge, etc. 2,100	Mechanical lab't'y ..... $7,500 Veterinary lab't'y ..... 5,400 Armory ..... 5,000 One dwelling 4,000	Boiler house One dwelling $5,000 3,000	Library Chemical lab't'y addi. $35,000 Barns 6,000 2,775	Botanical lab't'y One dwelling $6,000 3,000	Wells hall $25,000	Bridge $800	Greenhouse Three dwellings $8,000 18,000	Williams hall, 1869 ..... $30,000 Chemical lab't'y, 1871. 10,000
General account	$226,125 00	$5,000 00	$16,450 00	$9,800 00	$30,100 00	$22,200 00	$8,000 00	$33,775 00	$9,000 00	$25,000 00	$800 00	$26,000 00	$40,000 00
Repairs	466,211 48						16,770 00	14,498 00	9,943 60	12,200 00	15,276 00	34,796 00	363,627 88
Library	53,438 60	13,500 00	7,800 00	5,000 00	1,400 00	3,147 00	6,720 00	1,576 00	1,290 00	3,691 60	5,500 00	3,764 00	
Farm	25,055 00	2,000 00	2,000 00	2,000 00	3,000 00	3,300 00	3,135 00	3,000 00	2,000 00	1,190 00	1,000 00	1,440 00	
Garden	27,075 64	900 00	2,100 00	800 00	2,815 00	4,310 00	3,399 00	4,175 00	4,016 64	2,400 00	1,670 00		
Greenhouse	12,041 00	200 00	570 00	500 00	1,250 00	432 00	1,942 00	3,220 00	2,810 00	947 00	720 00		
Botany	2,765 00		530 00	600 00	340 00	1,295 00							
Chemistry	5,331 00		500 00	1,000 00	800 00	800 00	2,231 00						
Zoology	13,955 00		500 00	1,500 00	2,060 00	2,500 00	1,000 00	3,000 00	1,000 00	1,380 00	1,075 00		
Veterinary	10,296 00	225 00	700 00	1,500 00	1,500 00	1,500 00	1,945 00	1,000 00	800 00	480 00	646 00		
Mathematics	2,586 00		100 00	200 00	200 00	2,086 00							
Mechanical	6,090 00	500 00	200 00	475 00	600 00	450 00	700 00	2,020 00	1,020 00	125 00			
Steam and water	15,200 00		1,500 00	2,200 00	4,060 00	5,200 00	1,000 00	300 00					
Institutes	20,832 00		2,045 00	2,920 00	7,500 00	1,400 00	4,267 00				2,700 00		
Student labor	9,800 00	4,000 00	1,500 00	800 00	600 00	600 00	600 00	600 00	600 00	500 00			
Weather service	40,000 00	8,000 00	8,000 00	8,000 00	8,000 00	8,000 00							
Sundry	16,937 50			8,350 00	8,587 50								
	8,960 00	3,400 00	1,400 00	500 00	2,100 00				600 00	660 00	800 00		
Totals	$962,699 22	$37,725 00	$15,895 00	$48,145 00	$74,792 50	$57,730 00	$51,089 00	$67,164 00	$33,080 24	$48,678 60	$29,787 00	$66,000 00	$402,627 88
Annual tax on each $1,000 of assessment		†$.05½	$.01⅝	$.02	$.02½	$.04	$.03½	$.03½-7	$.04½-7	$.02⅝	$.04	$.02½	$.05¼	$.063
*Aggregate tax to date on each $1,000 of assessment		$2.00	$2.0367	$2.0086	$1.968	$1.912	$1.833	$1.7657	$1.7026	$1.6197	$1.5672	$1.49	$1.4407	$1.3359
Assessed valuation of State in millions of dollars			1,130	1.130	945.45	945.45	810	810	810	630	630	630	630	137 to 630

*Counting only taxes actually levied and omitting land grants. † Average.

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TABLE NO. 17.—*Income of the State Agricultural College from all outside sources from the date of its foundation to the present time.*

Year.	From State legislature.			From U. S. congress.			Total.
	For current expenses.	For special purposes.	Land sales, salt spring and swamp land grants.	Morrill act of 1862, interest from land grant.	Hatch act of 1887, experiment station.	Morrill act of 1890, supplementary endowment.	
1855			$56,320 00				$56,320 00
1856							
1857	$40,000 00						40,000 00
1858							
1859	37,500 00						37,500 00
1860							
1861	6,500 00		152 25				6,652 25
1862	10,000 00		218 97				10,218 97
1863	9,000 00		407 80				9,407 80
1864	9,000 00		726 09				9,726 09
1865	15,000 00		1,156 61				16,156 61
1866	15,000 00		1,094 27				16,094 27
1867	20,000 00		7,608 38				27,608 38
1868	20,000 00		592 49				20,592 49
1869	20,000 00	$30,000 00	17,559 00	$58 96			67,617 96
1870	20,000 00		1,320 02	2,720 93			24,040 95
1871	18,250 00	10,500 00	4,135 72	3,785 84			36,671 56
1872	18,250 00	3,000 00	317 05	7,175 65			28,642 70
1873	21,796 00	15,602 00	10 13	11,059 06			48,467 19
1874	13,900 00	15,602 00	150 13	14,061 98			43,814 11
1875	7,638 00	7,755 50	144 53	14,446 14			29,984 17
1876	7,638 00	6,755 50	1,773 09	16,830 17			32,996 76
1877	6,150 00	30,686 80	979 06	15,172 86			52,988 72
1878	6,150 00	5,686 80	826 60	15,807 09			28,470 49
1879	4,971 80	16,068 32	712 22	16,978 22			38,730 56
1880	4,971 80	7,068 32	797 55	17,837 24			30,674 91
1881	7,249 00	43,720 50	461 96	20,935 25			72,366 70
1882	7,249 00	8,945 50	358 46	22,507 45			39,060 41
1883	8,385 00	23,798 00	391 95	30,749 60			63,319 55
1884	8,385 00	10,526 00	1,269 90	27,909 72			48,080 62
1885		35,103 00	187 50	29,770 40			65,060 90
1886		22,617 00		30,461 04			53,078 04
1887		* 44,040 00	† 198 20	† 24,611 37			68,849 57
1888		30,752 50	444 20	32,406 60	$15,000 00		78,603 30
1889		* 20,973 00	10 50	31,323 69	15,000 00		67,306 19
1890		* 27,172 00	238 50	32,360 64	15,000 00	§ $15,000 00	89,771 14
1891		22,947 50	87 38	34,750 54	15,000 00	16,000 00	88,735 42
1892		22,947 50	127 38	34,948 12	15,000 00	17,000 00	90,033 00
1893		16,863 50	10 50	37,927 04	15,000 00	18,000 00	87,800 04
1894		16,863 50	483 59	44,527 26	15,000 00	19,000 00	95,823 35
Totals	$362,063 60	$495,967 74	$101,071 97	$571,121 86	$105,000 00	$83,000 00	$1,720,265 17

* Including appropriations for weather service.
† Oct. 1, 1886, to June 30, 1887, nine months.
§ Received Nov. 15, 1890.

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A SUMMARY OF THE RESOURCES OF THE STATE AGRICULTURAL COLLEGE.

Farm, buildings and equipments, as per inventory on pp.	$478,714 40
Agricultural College trust fund, from sale of lands of United States grant.	525,937 98
Balance due on purchase money " " " " " " " "	79,341 75
102,990 acres @ $5 per acre as yet unsold " " " " " "	514,950 00
320 acres @ $5 per acre yet unsold of swamp land grant	1,600 00
Total	$1,600,544 13

The 102,990 acres yet vacant of the U. S. land grant are given in detail as located in the different counties in table No. 11, p. 16.

The 320 acres of swamp land is what still remains unsold of a grant from the State to the College of swamp lands located in the township of Bath, in Clinton county.

The present amount of the trust fund is taken from the last line (that for 1894) of the fifth column of table No. 12, p. 17.

The balance due on purchase money is reported by the Commissioner of the State Land Office, and consists of the total amount for which the College lands have been sold up to the present time, *i. e.:*

The total of the fourth column from the right in table No. 10, p. 15	$657,337 76	
Less the payments made on these sales, constituting the trust fund	525,937 98	
		$131,399 78
And less balances unpaid on abandoned descriptions which have reverted to the State by forfeiture for non-payment of interest, as shown in the third column from the right, in table No. 10, page		52,058 03
		$79,341 75

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DEPARTMENT REPORTS.

PRESIDENT'S REPORT.

To the State Board of Agriculture:

GENTLEMEN—I have the honor to submit herewith my report for the year ending June 30, 1894, accompanied by those of the professors in charge of the several departments.

My term of office began August 30, 1893, hence my portion of the report dates from that time.

CHANGES IN THE FACULTY.

At the beginning of my administration there were several changes in the faculty. The professor of mechanical engineering, assistant professor of mechanical engineering, and the foreman of the wood shop had resigned to accept similar positions at Champaign, Ill. The assistant professor of mathematics resigned to accept a position in the Michigan Mining School. There were also vacancies in the positions of assistant professor of history and political economy, instructors in English and agriculture, assistant agriculturist for the Experiment Station, and the assistant to the Director of the Experiment Station. During the year the assistant professor of horticulture resigned to go to the Vermont Experiment Station, and the professor of zoölogy, geology and physiology resigned to accept a position in Pomona College, California. The assistant in botany resigned to accept a position in the Department of Agriculture at Washington. Besides these, the professor of agriculture entered upon his duties at the opening of the school year. While we were unfortunate in losing a number of good men, those who have taken their places have done admirable work.

THE COURSE OF STUDY.

There were few changes in the regular course of study from the previous year, but for the coming year there have been a number of changes, the most important of which are the addition of more instruction in agriculture and a rearrangement of studies to make them come more in their natural

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order. On January 3 we organized a special course in dairy husbandry, the work of which was highly successful. A full account of the work done in this new department may be found in the report of the professor of agriculture. I heartily recommend the continuance of the short winter course, and hope that the legislature may see fit to make an appropriation for the purpose of erecting a suitable building for dairy work. We were fortunate in receiving a large part of the Michigan exhibit at the Columbian Exposition. This exhibit is now considerably scattered among our different buildings, and a special building to accommodate our museum will be needed in the near future.

FARM HOME READING CIRCLE.

The work of the Farm Home Reading Circle has been greatly enlarged during the year. A much larger number of books has been ordered than ever before, and the interest taken throughout the State in this department has been very encouraging. I wish to express my gratitude to the "Grange Visitor" for its hearty coöperation in this work, and to Prof. F. B. Mumford, who has been untiring in his efforts to make it a success.

ENROLLMENT OF STUDENTS.

The enrollment of students for the past year has been as follows:

	Agricultural.	Mechanical.	Ladies.	Total.
Graduates	4	3	1	8
Seniors	19	12	----	31
Juniors	29	19	----	48
Sophomores	39	38	2	79
Freshmen	59	45	3	107
Specials	49	9	18	76
Dairy students, not counted above	17	----	----	17
Total	216	126	24	366

This is slightly in excess of the number enrolled last year.

IMPROVEMENTS.

During the year over 40,000 feet of artificial stone walk has been laid; a system of sewers has been put in, an addition to the house of the horticulturist has been made, important changes have been made in the mechanical shops, including the building of a new foundry and changes in the blacksmith shop, a new gallery has been erected in the library, a new hospital is being built, and various repairs have been made in the dormitories and other buildings.

INSTITUTES.

The work of the Farmers' Institutes was carried on during the months of December, January and February. The great educational value of these Institutes is beyond question. The large attendance and the interest

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manifested show the appreciation by the people. We hope in the future to extend this work and make it a very prominent feature of the College work.

COMMENCEMENT.

The commencement exercises opened on Sunday, August 5, with the baccalaureate address by the President. Monday evening, class-day exercises; Tuesday evening, senior reception; Wednesday evening, President's reception; Thursday afternoon, dress-parade by cadet corps; Thursday evening, reunion of College societies; Friday morning, commencement exercises, followed by commencement and Alumni dinner; public exercises of Alumni Association, triennial, were held in the evening, and Saturday morning the triennial business meeting of the Alumni Association closed the exercises.

Degrees were conferred upon the persons named as follows: The degree of Bachelor of Science upon

Barnum, Cecil J.,	Nies, John D.,	Smith, Clarence B.,
Campbell, R. S.,	Pashby, Cyrus C.,	Tracy, Harry W.,
Foreman, Clarence J.,	Perrigo, John W.,	Welsh, Robert S.,
Groner, Orel S.,	Plummer, Leo B.,	Wight, William F.,
Johnston, Ernest V.,	Rittinger, John W.,	Wilson, Leroy A.,
McArthur, Duncan D.,	Scott, Silas F.,	Woodworth, Robert S.,
Newell, Vinton V.,	Simons, Geo. E.,	Leipprandt, Charles W.

The degree of Bachelor of Science was also conferred upon William K. Sagendorph, of the class of '92. The degree of Master of Science was conferred upon Geo. L. Teller and Fred B. Mumford, and the degree of Master of Agriculture upon Arthur C. Bird.

GENERAL CONDITION.

During the year the general condition of the College has been good. The students have manifested an earnestness in their work, and in general a desire for order and good government in the dormitories. There have been few cases requiring discipline, and no disturbances of a serious nature.

Respectfully submitted,

LEWIS G. GORTON,

President.

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REPORT OF THE DEPARTMENT OF PRACTICAL AGRICULTURE.

To the President:

SIR—I have the honor to submit herewith the annual report of the Department of Practical Agriculture for the year ending June 30, 1894.

CHANGES IN TEACHING FORCE.

The resignation of Professor P. M. Harwood took effect September 1, 1893, and my connection with the College then began.

At the same time F. B. Mumford, who had been an assistant in in the department, was elected assistant professor of agriculture; and Mr. A. T. Stevens, a graduate of the College in the class of 1893, was elected assistant in the College work. Mr. H. E. VanNorman has given instruction in the care of milk and buttermaking, both to the dairy class in the winter, and to the regular College students since.

CLASS INSTRUCTION.

The regular course of lectures on soils and crops to the sophomores was given by Professor Mumford in the spring term. At the same time I gave instruction in the history and characteristics of the prominent breeds of domestic animals to the freshmen by lectures, accompanied by a study, in the yards, of the specimens of those breeds kept by the College or found in the stables of neighboring breeders. Especial attention was given to the qualities of the various breeds that adapt them to Michigan conditions.

During the same term careful and painstaking work, under the supervision of Mr. Stevens, was done by the sophomores in tracing pedigrees and becoming familiar with the names of the early breeders of live stock and the style of animal each of them tried to develop.

A course of lectures was given to the seniors and sophomores by myself on the physical and chemical properties of milk and dairy methods, supplemented by practical work in the dairy room until the student became proficient in the art of buttermaking.

Two courses of lectures were given in the summer term, one on Stock Breeding, and the other on Stock Feeding.

In the new course of study adopted recently by the faculty, much more time is given to studies in practical agriculture. The sequence of studies given in this department will be as follows:

FRESHMAN YEAR.

Spring Term.—History of Breeds of Live Stock.

JUNIOR YEAR.

Fall Term.—Lectures on Stock Breeding and on the History of Agriculture, Farm Management and Accounts.

Spring Term.—Sixty lectures on Stock Feeding.

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Summer Term.—Twenty-four lectures on Soils and Crops, sixty lectures and exercises on Grasses, Weeds, Seeds, and the Identification and Cultivation of Forage Plants Generally.

SENIOR YEAR.

Fall Term.—Lectures and readings on Farm Economy, Farm Management, Construction of Buildings, with discussions of topics of interest in connection with agricultural development.

STUDENT LABOR.

Much thought has been given to the solution of the many perplexing questions in relation to student labor. By a law of the State and a rule of the Board, each student in the agricultural course is required to devote two and one half hours of each day for five days in the week to manual labor on the farm or garden. It has been our aim to make this work as helpful to the student as possible, and have it at the same time financially valuable to the College. One half of the freshmen class, all the sophomores, and such seniors as elect are assigned to this department for work.

The hours for this labor are from 1 to 3:30 p. m. During these hours the whole student body reports for work, laboratory, or shop practice. It is manifestly impossible to utilize the labor of any force of men to good advantage under these conditions. The attempt is not made, therefore, to do any great share of the regular farm work by student labor.

To make the manual labor an integral and valuable part of the education which the student acquires at the College, the following plan is pursued:

In the freshman year the student is assigned to all kinds of jobs, some of them involving details, the knowledge of which may be valuable to him later. He is asked to do many things also that are necessary, but which are not and can not be educational. For all work not strictly educational in its nature he receives pay. During this year he is instructed in some of the practical details of farm work, such as fence building, road making, cultivating and harvesting certain farm crops, exterminating certain weeds, splicing ropes, and drainage.

At the beginning of the spring term, to each sophomore is assigned some special kind of work, to which his principal attention is to be devoted for the entire year. He may be assigned some experiment connected, for instance, with the growth of the corn crop. He will be expected to see to the proper preparation of the ground in the circumscribed area assigned him for his experiment, select the seed, plant it; watch its germination and growth, report the object and progress of his experiment frequently at stated intervals to the class, cultivate and harvest the crop, noting at all times with great care the particular points that are to be studied in the given experiment.

To another sophomore may be assigned an experiment in wheat culture involving the study of some peculiar feature of its growth or some disease and methods of prevention; to another, some experiment in the cultivation of oats, and so on through the whole catalogue of our ordinary farm crops. The class meets at not infrequent regular intervals, and an afternoon is spent in discussing these experiments. By this means each member of the class learns what the others are doing and reaps the benefits of all the work performed.

The results of this method of managing the student labor system are very encouraging. The students themselves take a deep interest in their

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work, acquire habits of careful observation and taking copious and accurate notes, and at the same time become acquainted with the right methods of doing farm work.

In the sophomore year the student is also required to become somewhat expert in the art of fine butter making. Beginning with the milk as it is drawn from the cow, he is required to test it with the Babcock tester, set it in creamers or run it through separators—the setting up, speeding, oiling and management of which he must learn—cool, care for, and ripen the cream, churn, work, wash, salt, and pack the butter. All these details he does over and over again until he becomes thoroughly familiar with every one of them.

In selecting work for the seniors the choice of the student is consulted. To some of them are assigned experiments in stock feeding or dairy husbandry which require the analyses of fodders, manures, or milk and its products. Others elect experiments related to chemistry, botany, or entomology. All of these experiments involve original investigation and the results are often of sufficient value to the public to warrant their publication in the bulletins of the station.

SPECIAL DAIRY COURSE.

During the winter a Special Dairy Course was given at the College, beginning January 4, and continuing six weeks. Circulars announcing the proposed course were not issued until late in the preceding fall, yet before the beginning of the term more applicants presented themselves than we could accommodate. The total number in attendance was 27, of whom 23 completed the course.

The sole room available for the practical work was the large room in the basement of the agricultural laboratory, in which the heater was located. By a partition this room was divided into an engine and boiler room and a dairy room. The utensils were washed and stored in a smaller room adjoining.

The dairy room had capacity for eight churns in operation although interfering to some extent with the hand and steam separators and the four creamers located in the same room.

The milk testing was done in still another room near the foot of the stairs.

Beginning with the milk as it came to the building from the farmers or the herd, the students learned first to test it with the Babcock tester. The importance of this apparatus can not be overestimated and its presence in every creamery is a certainty in the near future. Much attention was therefore given to inculcating careful habits of skillful manipulation and correct reading.

From the testing room the student went to the separators. These costly machines he studied and handled until he understood every detail of their construction and management, and until he could be safely entrusted with one in actual operation in a creamery.

He then studied the various creamers and learned the general principles governing their operation and the details of setting and skimming milk, where the cold deep setting process is used.

Then came a careful study of the conditions requisite to the development of the right flavor in ripening cream. Cleanliness, right temperatures, and the right set of bacteria were described as necessary, and the student

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was shown how best and easiest to attain the desired results. Constant daily practice in churning, washing, salting, working, and packing the butter followed. The student performed all the operations of the dairy, thermometer in hand, carefully noting and recording every detail of every operation, temperatures, acidity, time required, weights and all other matters. As a result the records of the work done at the dairy school last winter form an almost inexhaustible mine of information bearing on practical dairy work.

Notwithstanding the fact that the utensils used were just such as the ordinary farmer should be provided with, and the methods employed pertained rather to the private dairy than the public creamery, yet the general principles, the requirements for properly handling milk and its products are the same the world over, and we find that a large proportion of the young men attending the school last winter have taken places in some of our best creameries in the State, and are doing work creditable alike to themselves and the College.

Along with this practical work, explaining the reasons for the various processes and giving a rational basis for the methods employed, was given a course of lectures on dairy chemistry and physics. This set of lectures included discussions of such topics as the composition of whole milk, skim-milk, butter and buttermilk; variations in the composition of normal whole milk due to lapse of the period of lactation, changes of feed, or other causes; relation of bacteria to the ripening of cream; relation of temperature to the efficiency of churning and methods of preventing losses in skim-milk or buttermilk.

With this course there was also given a somewhat full description of the methods of factory management, the use of the test in factory work, methods of factory bookkeeping, paying for milk according to its content of butterfat and other details, a knowledge of which is necessary to the successful operation of a modern creamery.

Dr. E. A. A. Grange gave to the class a course of lectures on bovine anatomy and the care of cows from a hygienic standpoint. Dr. W. J. Beal taught the use of the microscope, and gave the students a clear insight into the appearance of the fat globules, and other microscopic peculiarities of milk and its products. He also gave a course of exercises of great value to the class on grasses and forage plants.

Under the skillful supervision of Mr. M. F. Loomis the class had practice in the management of boilers and engines. They were taught how to economize fuel, how to detect adulteration of lubricating oils, how to set up, run, oil, speed, and operate engines, calculate the speed of shafts and the size of required pulleys, and such details of mechanics as would be valuable to them in creamery management.

A feature of the course that proved of benefit to the class was the set of lectures delivered by prominent dairymen in the State invited to the college for that purpose. The thanks of the Board are due to the following gentlemen for their valuable addresses: Mr. John I. Breck, Jackson; Hon. F. E. Mills, Ann Arbor; Mr. J. H. Brown, Climax; Mr. E. E. Rockwood, Flint; Mr. J. N. McBride, Burton.

After the close of the special dairy course, opportunity has been afforded the regular College students to take dairy work. Hereafter this work will be required of all agricultural students and will form an essential part of their course.

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INSTITUTE WORK.

So much of my time was taken up by the preparation for the special dairy course that I was unable to take as active a part in the Institute work as I could desire. This work is invaluable to the man who is to do the teaching of subjects intimately related to practical agriculture. No where else can he find as good an opportunity to put himself in touch with the people and find out their exact situation and wants. It is unfortunate in this regard that the special dairy course must come in the winter. My presence at the College is then imperatively demanded as is the presence of one of the professors of chemistry. Last season I attended, for one day each, the Institutes at Greenville, Battle Creek, and Coldwater, lecturing to the dairy students the other five days of the week. Before the dairy course opened I attended the series of Institutes at Shelby and Hersey, and after it closed, the one at Ithaca, besides attending the annual meeting of the State Dairymen's Association at Saginaw as a delegate from the College.

Professor Mumford attended the Institutes at Allegan, Sparta, Alto, Stockbridge, Highland, Yale and Standish.

At the urgent invitation of the communities interested, I have spoken on dairy topics at St. Johns, Niles, Coldwater, Woodland, Lake Odessa and Middleville. Owing to pressure of work at the College I have had to decline other invitations equally as pressing from other places. I regard this contact of the College with the people especially valuable, both in the good done the community visited, and in correcting false impressions of our aim and methods. An extension of the work along this line cannot fail to be of benefit to the College.

IMPROVEMENTS.

At the last session of the legislature $500 was appropriated for drainage on the College farm. Of this amount $300 has been expended in draining field No. 12, converting what has heretofore been a piece of waste land into one of the best and most productive fields on the farm. In laying out the drains the land was carefully surveyed and mapped by students and the drains so placed as to be most effective at the least cost.

A new steel wire fence with steel posts has been erected between fields Nos. 6 and 8.

Field No. 4, lying back of the station barn, has been divided into convenient lots extending to the river by new wire fences, erected by the students. Most of these fences have been donated to the College and form a museum of the best makes of fences sold in the state and an invaluable object lesson to visitors and students.

An electric motor of ten horse power capacity, recently purchased, is an important addition to the equipment of the department. The necessity of maintaining an engine and boiler for grinding grain and hiring annually a portable engine for cutting ensilage or threshing is entirely obviated. The motor is placed on runners and is readily moved to any place where power is needed. The current is furnished by the boiler and engines of the central heating and power plant.

The State and College World's Fair agricultural exhibit has been received and forms a valuable addition to the museum. Three weeks were spent in

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Chicago last fall by Professor Mumford in taking it down and packing for shipment to the College.

The large room in the second story of the agricultural laboratory has been fitted up for its reception where it now forms an instructive exhibit of interest to both visitors and students.

COLLEGE HERD.

During the year the herd of Shorthorns has been reduced by sales, and the dairy herd somewhat increased by the retention and breeding of the heifer calves of the Jersey and Holstein breeds. The herd as a whole is in a very thrifty condition owing, in large measure, to the good care given them by the herdsman, Mr. Richard Harrison.

There are on the farm fifty head of pure bred cattle distributed among the prominent breeds as shown by the following table:

	Bulls.	Cows in milk.	Heifers.	Calves.
Shorthorns	2	5	4	1
Holsteins	2	10	5	4
Jerseys		1	4	2
Guernseys		1	3	
Brown Swiss	1		2	
Polled Angus		1		
Hereford		1		
Ayrshire		1		

The records made by three of the Holsteins are highly satisfactory, and are tabulated below.

Rosa Bonheur 5th, 11227, H. F. H. B., calved on the 6th of February. Her record began on the 20th of the same month.

Houwtje D, 12005, H. F. H. B., calved on the 25th of April, and Belle Sarcastic, a four year old heifer, calved on the 13th of April.

Their largest yields are as follows:

	Daily.		Weekly.		30 days.	
	Milk.	Butter.	Milk.	Butter.	Milk.	Butter.
Rosa Bonheur 5th	106.75	3.5	726.75	22 25	3,088.	92.35
Houwtje D.	91.1	3.3	627.9	21.	2,581.8	82.
Belle Sarcastic	81.9	2.99	553.3	19.	2,296.8	71.11

There are on the farm 15 pure bred Duroc Jersey swine, one Essex sow and 11 grade pigs.

The flock of sheep contains 58 Shropshires, two Leicesters, four Merinos, six Hampshires, two Oxfordshires, six Cotswolds, two Lincolns, three Horned Dorsets, and two grade lambs.

For purposes of class illustration the department needs good individuals of several other breeds of live stock.

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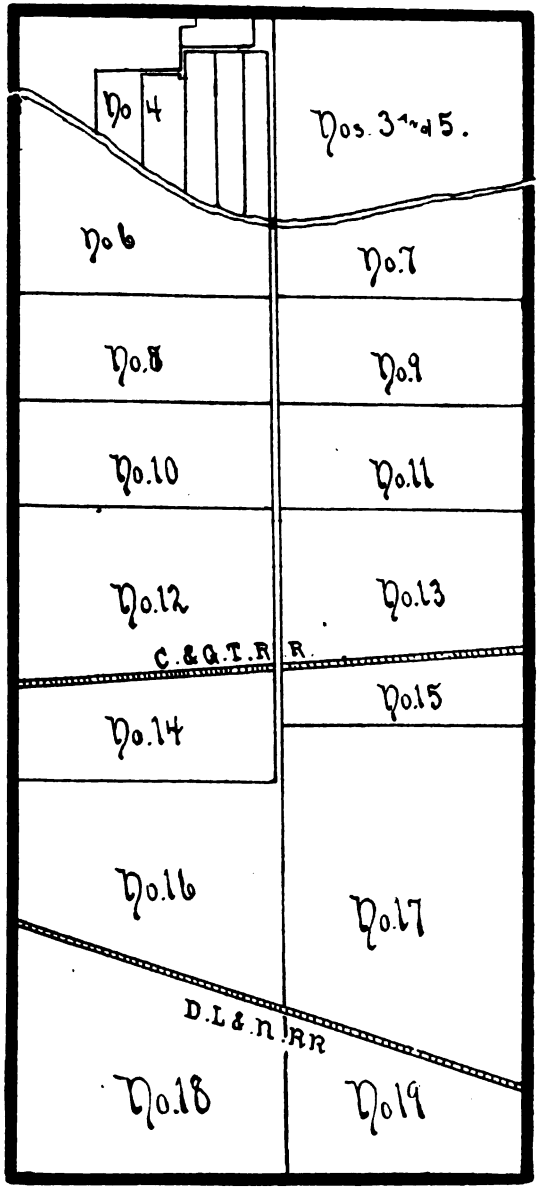
FARM CROPS.

The foreman, Mr. Ernst Wittstock, has superintended the execution of the details of the farm work in a very satisfactory manner.

The accompanying map will show the distribution of the crops for the year 1894.



LOCATION OF FIELDS ON COLLEGE FARM.

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Field.	Area.	Crop.
3		Experimental plots.
4		Small pasture lots.
5		Experimental plots.
6	27.64 acres	20 acres hay, remainder roots and forage plants.
7	17.07 "	Wheat yielding 30 bushels per acre.
8	23.66 "	Corn.
9	23.78 "	Pasture.
10	23.55 "	Hay yielding two tons of timothy per acre.
11	23.95 "	Oats.
12	24.5 "	Oats yielding 38 bushels per acre.
13	30 "	Corn.
14	20.9 "	Oats and peas and afterwards rape.
15	18.15 "	Wheat.
16	44.19 "	Pasture.
17		Woods.
18		"
19		"

DONATIONS.

The makers of dairy and farm implements and fences have been quick to appreciate the advantage of having their wares in use on the College farm, and have generously donated their goods, often unsolicited, and to the great benefit of the department. Below is given a list of these donors, their places of manufacture, the goods donated, and the market value. The thanks of the Board are due them for their generous appreciation of the work of the College.

Donor.	Address.	Donation.	Value.
Homer Fence Co.	Homer, Mich.	8 rods of wire fence	$5 20
Sedgwick Brothers	Richmond, Ind.	200 feet of wire fence	8 54
Tecumseh Fence Co.	Tecumseh, Mich.	10 rods of Jones fence	9 00
Buchanan Fence Co.	Smithville, Ohio	10 rods of Buchanan fence	3 50
D. G. Fitz	Rew, Mich.	10 rods of T. J. Smith fence	11 10
G. G. Dexter	South Alabama, N. Y.	Tightener and stays	3 00
Keystone Woven Wire Fence Co.	Tremont, Ill.	10 rods wire fence	7 00
Hartman Manufacturing Co.	Ellwood City, Pa.	3 rods lawn fence	9 90
Gale Manufacturing Co.	Albion, Mich.	Daisy cultivator	20 00
S. I. Allen & Co.	Philadelphia, Pa.	Planet, Jr., cultivator	10 00
Chambers, Bering & Quinlan	Decatur, Ill.	Side Delivery rake	65 00
Heller Manufacturing Co.	Montclair, N. J.	Riding Harrow	15 00
W. W. Myers	Portland, Mich.	Root cutter	25 00
Flint Creamer Co.	Flint, Mich.	Creamer	35 00
Leonard Brothers	Grand Rapids, Mich.	Creamer	35 00

RECOMMENDATIONS.

The most prominent and pressing need of the department is a separate dairy building equipped for giving instruction in both butter and cheese making. During the past winter the work in butter making has been carried on in a manner not altogether satisfactory, owing to the smallness of the rooms in the basement of the laboratory. Obviously no attempt could be made to teach the use of steam separators, churns and butterworkers, or factory methods of any kind in such narrow quarters. There is moreover a growing demand for thorough instruction in cheese making. This can be given in the winter in no room other than one specially fitted for

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the purpose, provided with suitable vats and other apparatus, and with hot and cold water and steam. Such a room must be large to accommodate any reasonable number of students, and be well lighted. No such room can be found on the campus. In this particular, the other states of the Union in which the dairy business is an important factor in the agricultural development and prosperity are ahead of Michigan. Most of such states have already made ample provision for a dairy school. Our success last winter and the phenomenally large number of applications for admission to the class next season warrant me in recommending that an appeal be made to the legislature for funds to erect a suitable dairy building.

I cannot close this report without expressing my appreciation of the hearty coöperation and the painstaking skill of my colleague and assistant in the department. Whatever measure of success we have attained in our educational work is due to the united efforts of the whole teaching force. Professor Mumford has managed the student labor with great wisdom and success. In this work he has been ably assisted by Mr. Stevens and by Mr. Crozier of the Experiment Station. The latter has made use of the students in the performance of the field experiments with satisfactory results. The work has been well performed and the students have profited by the experience thus gained.

Mr. Stevens has given invaluable aid in the instruction of the students in pedigree work, in certain phases of the dairy work including the microscopic appearances of milk and its products, and in the cryptogamic diseases of our farm crops as far as such instruction falls within the domain of this department. The year has been one of hard work but of perfect harmony.

I cannot refrain from expressing my continual obligations to the departments of chemistry and botany for the material assistance they have rendered us in the prosecution of our work. Not only have they been willing collaborators with us in our experiments, but they have as well aided us by the use of their laboratories and equipment and by the supervision of students in work preparatory to their specially assigned experiments. From the first their attitude has been one of extreme kindness and readiness to assist in all possible ways.

The wise and timely counsel and advice of the Farm Committee of the Board of Agriculture has been an important factor in our success. Since the beginning of my connection with the institution, no request has been preferred to the Board by this department that has not met with immediate consideration and wise decision. I take great pleasure therefore in expressing my appreciation of their kindness.

Respectfully submitted,

CLINTON D. SMITH,

Professor of Agriculture.

AGRICULTURAL COLLEGE, MICH.,
June 30, 1894.

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REPORT OF THE DEPARTMENT OF HORTICULTURE AND LANDSCAPE GARDENING.

To the President:

SIR—I herewith have the honor to present a report of the operations of this department for the past year. In my last report, submitted at the close of the fall term, an account was given of the work performed up to that time and reference may be made to that for the first four months of the year.

The instruction in landscape gardening having been given during the first half of the fall term, the only class room instruction that fell to the department was the twelve weeks of horticulture to the juniors, in the spring term. Although the time was altogether inadequate for the purpose, the subjects of plant propagation, pomology, vegetable gardening and floriculture received attention.

At best the merest outline of the subjects could be given, but as the students were assigned to this department for two and one-half hours each afternoon, many of the deficiencies were made good.

LABORATORY WORK.

Throughout the college year, the members of the junior class are assigned to such duties as will give them practice in gardening operations. During the first half of the spring term, before the regular out-door work of the year begins, they are given such practical work as grafting, both root grafting and top grafting by the various methods; the making of cuttings of all kinds; pricking out, potting and repotting plants; the sowing of vegetable and flower seeds; the making of hot beds; studying the construction of greenhouses of various kinds, drawing plans and estimating the amount and cost of the material required for the same; preparing insecticides and fungicides from the various approved formulæ; pruning grapes and the various orchard and small fruits. During the remainder of the year practice is afforded in various other operations such as planting trees, setting out small fruits, sowing the seeds of the various vegetable crops and caring for and transplanting those that have been started under glass; the care of the hot beds; spraying the various crops for insects and diseases. Considerable attention is also given to nursery work, beginning with the planting of the grafts that were made in the spring and ending with digging and heeling in the trees that are large enough for orchard planting. In the spring the trees that are not required for our own planting are distributed for trial among the fruitgrowers in different parts of the State, a large number being sent to the homes of present and former students. This gave the class excellent practice in handling and packing trees, as about 125 bales and bundles of trees and plants were distributed. During the summer the grafts and seedlings are pruned and cared for, and in July and August the latter are budded. Practice in greenhouse work and in laying out, planting and tending flower beds is also afforded.

Except for four weeks in the first part of the spring term this work is for the most part so planned as to be of value to the department and is paid

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for. As the different crops mature, the students are from time to time required to make a study of the characteristics of the different species, and the leading varieties of each.

STUDENT LABOR.

Although the work outlined above is a part of the so-called manual labor of the students, it is given under the head of "laboratory work" to show what advantages for instruction in practical horticulture are afforded to the students in the regular course, and the line of work that is required of all students during the junior year.

In addition to the members of the junior class, about one-half of the freshmen and such seniors as may elect are assigned to work on this department. (Strictly speaking, the juniors are assigned for the second and third terms and the seniors for the fall term, for the regular work in this department.)

As a large part of the regular work of the department is experimental in its nature, consisting in testing varieties of fruits and vegetables and various methods of handling the crops, and fighting the insects and diseases, we have arranged to assign the different crops to the care of the members of the junior class, and the work upon them is done under their direction, with the supervision of my assistants, and when they have nothing in their own line that needs attention they assist some one else, and thus have more or less to do with the different crops.

In the work of the department there is a large amount of labor, such as weeding, hoeing, picking berries and other fruits, caring for the drives and lawns, which partakes somewhat of the nature of drudgery, especially after it has been performed a few times. Such work for the most part falls to the freshmen. With the exception of a little outside help during the rush of the season, the work of the department, including the care of the grounds, orchards and gardens, and much of our experimental work, is done by the students, with the exception of the necessary teamsters and foremen.

GARDENS AND ORCHARDS.

In the orchards the planting for the past six years has been almost entirely for the purpose of securing promising varieties for trial and for illustration to the students. While they are cared for by the students, the results are largely made use of by the Experiment Station, and the report of the work in that line, and the condition of the trees, will be given in my report as horticulturist of the Experiment Station. Much the same may be said of the vegetable garden, but in addition to the purely experimental crops, we grow a general collection of garden vegetables, thus giving the students a practical insight into the methods of market gardening, and supplying fresh vegetables to the boarding clubs and the members of the faculty.

THE GREENHOUSE.

The greenhouses have remained in the charge of Mr. Thos. Gunson, and if the opinions expressed by the public are to be trusted, they have never been kept in better condition. The small palms, dracænas,

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anthuriums and other stove plants added to the collection in 1892, have made a good growth, and will soon become fine specimens The repairs made to the workroom in the autumn of 1893 have added both to the general appearance of the premises and to the conveniences for handling plants and flowers.

Most of the orchids have flowered during the year, and, as usual, have attracted much attention. The large plant of Abyssinian banana having become too tall for the house, was removed, and its successor is now crowding hard against the glass. A plant of a dwarf banana (*Musa Cavendishii*), has matured its fruit during the summer. The bunch weighed sixty pounds and numbered one hundred and eighty fruits, which equalled in quality those sold in our markets. A plant of the true edible banana (*Musa sapientum*), is now in flower, and will mature its bunch within the year.

The grapes placed in the grapery in 1892 have made a very good growth and are carrying satisfactory crops of fruit.

In the care of the houses Mr. Gunson has been assisted by Mr. U. P. Hedrick, '93, and by from five to eight students, who thus obtain experience in greenhouse work and aid in the care of the houses and the surrounding grounds.

THE GROUNDS.

The season of 1893 was so dry that the lawns were badly parched, and, as a result, the turf is very thin this season. A considerable quantity of fine compost was used in topdressing some of the poorest places. Although it was roughly graded around the walks last fall, several hundred loads of filling and compost were required to bring the ground about them to a suitable level, and the work is not yet completed. Some two thousand square feet of new walk has been built the present season, mostly by the work of our regular men, and for this we drew nearly one hundred yards of gravel and filling. The flower beds have been filled as usual, and in addition the hollow between the College Hall and Abbot Hall has been laid out in beds and planted. For this about ten thousand plants were used. Next year it is hoped that the ground will be sufficiently subdued for the planting of many of the choicer varieties of the herbaceous perennials.

A large number of shrubs and trees have been grown in the nursery and will be planted out the present year.

During the winter, and at odd times in the summer, the teams have been kept busy hauling gravel for the drives and manure from Lansing.

As noted in my last report, Mr. Gulley, who had acted as foreman for three years, resigned to accept the chair of horticulture in the Vermont Agricultural College. During the winter Mr. Coryell performed the duties of the foreman in addition to his regular work, and on the first of March the position was filled by the appointment of Mr. Thos. Durkin, of Geneva, New York. He had had a large experience in nursery and orchard work, and has handled the men and teams to good advantage, and is to be particularly commended for the neat appearance of the orchards and stables.

OUTSIDE WORK.

During the winter I attended the Institutes at Allegan, Sparta, Alto, Yale and Standish, and either Mr. Gladden or Mr. Coryell were at nearly all of the others.

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The meetings of the State Horticultural Society at Lawton and Charlotte were also attended, and I was present at the June meeting of the South Haven and Casco Pomological Society, and of the Eaton County Society.

Respectfully submitted,

L. R. TAFT,

Professor of Horticulture and Landscape Gardening.

AGRICULTURAL COLLEGE, MICH., *June 30, 1894.*

REPORT OF THE MECHANICAL DEPARTMENT.

JANUARY 1 TO JUNE 30, 1894.

To the President:

SIR—I handed you on December 30, 1893, a report of work done in the Mechanical Department during the previous four months, and the same appeared in the printed report of the Secretary of the State Board of Agriculture for 1893.

In my report for 1893 I noted changes that had been recently made in the shops and their equipment, and also called attention to changes being made and to certain work that was contemplated. I now take pleasure in reporting that the blacksmith shop and foundry (except placing crane in latter) have been completed and the wood shop altered according to the plans advanced at that time. The alterations in the wood shop include the proposed tool room. Also that changes in partitions between rooms were executed as proposed, establishing a separate wash and coat room. The blacksmith shop now contains twenty forges, and the system, proposed in my report for 1893, in use for furnishing the blast and removing smoke and gases gives the utmost satisfaction. The Case engine purchased for use with the foregoing system performs its work excellently.

The foundry has been in practical operation during the spring and summer terms. We now have on hand a considerable equipment of molders' tools, ladles, flasks, etc. The foundry has been found to be a valuable addition to our laboratory, as it both increases the scope of instruction and cheapens the former cost of finished material. The number of patterns and flasks is increasing rapidly, and we need a proper place to store them, also a place for foundry materials and general storage, therefore the consideration of plans for a combined storehouse and pattern loft would seem advisable. The need is particularly felt of an instructor able to devote his entire time to foundry work.

The number of small tools has been largely increased and, where possible, particularly in the machine and blacksmith shops, these small tools have been of our own manufacture.

An important addition to our machine shop equipment has been made by the purchase of a Norton emery grinder.

The 8x13x12 compound engine, constructed by the students, is now used

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to drive the shafting of machine and wood shop, and has been in successful operation since the beginning of the spring term. The 8x12 engine formerly used to drive the shops has been transferred to the steam department, and is now used to drive the dynamo employed for lighting the grounds.

Our testing laboratory equipment has been increased by the purchase of an extensometer and an aluminum reducing wheel. Our equipment has also been increased by securing a line of patterns for motors and dynamos, also drawings for same.

Plans have been prepared for a traveling crane and a hydraulic hoist for the foundry; some of the patterns and castings for the latter are completed. An air compressor has been completed by the students and is now in position in the west gallery. A rope drive to be used in connection with the cupola blower has been put in operation. Three wood lathes, under construction in '92-93, have been completed. We have a tempering furnace under construction; also a 5 H. P. electric motor.

A scrap book, with detachable pages, the material for contents of same taken from the catalogs of manufacturers of standard tools, engines, etc., has been prepared at considerable cost; the object being to make a book that would aid in giving instruction in machine designing. The benefit already derived from this scrap book shows the expenditure to have been a judicious one.

During the past term a full line of drawings of shop exercises have been prepared. We shall endeavor in the future to have all work in the shops executed from drawings, as is the custom in regular engineering establishments.

During the spring term the work was carried on as follows:

Seniors—Kinematics, Graphical Statics of Mechanism, and Steam Engineering (Laboratory), by Prof. Weil.

Advanced Machine Design, by Prof. Chamberlain.

Juniors—Machine Design, by Mr. Westcott.

Steam Boilers, by Prof. Weil.

Sophomores—Elements of Machine Design, by Mr. Westcott.

All Classes—Shop work, Prof. Chamberlain, Superintendent. Mr. Groesbeck in Machine shop, Mr. Theodore in Blacksmith shop, Mr. Bender in Pattern shop and Foundry.

During the summer term the work was carried on as follows:

Seniors—Engineering Practice, Thesis Work, and Original Design, by Prof. Weil.

Juniors—Strength of Materials, by Mr. Westcott.

Sophomores—Elements of Machine Design and Elements of Steam Engine, by Mr. Westcott.

All Classes—Shop work, as in spring term.

Attention is particularly called to the fact that we now have practically three new shops, Foundry, Blacksmith shop and Wood shop. Also that the equipping of these shops was, in a great degree, accomplished by the aid of student labor. A force of students was kept at work during the long vacation of '93-4.

Respectfully submitted,

CHAS. L. WEIL,
Professor of Mechanics.

AGRICULTURAL COLLEGE, MICH.,
June 30, 1894.

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REPORT OF THE CHEMICAL DEPARTMENT.

To the President:

SIR—The chemical department submits the following report of the work for the past year in the collegiate and in the experiment divisions of the department.

The year has been a prosperous one, and the chemical laboratory has been full of work for the College and the public for the entire year. To exhibit this relation of the chemical laboratory to the public service, a more extended statement than usual will be made of the work in this department.

EXHIBITS AT CHICAGO.

The quadri-centennial celebration at Chicago made large demands upon this department to properly illustrate the work of the College and of the State. At the solicitation of the Board of the World's Fair Managers for Michigan, a set of 38 characteristic soils, representing the leading kinds of soil, and from different localities, were selected, analyzed, and mounted in glass show bottles, the labels stating the locality, kind of timber growing thereon, and a complete chemical analysis. Two full sets of such soils were put up and displayed—one in the Michigan division of Agricultural Hall, and one in the Agricultural College exhibit in Hall of Liberal Arts. A bulletin, No. 99, stating more fully the locality and characteristics of these soils, was on hand for free distribution.

A full set of the commercial fertilizers on sale in Michigan for 1893 was mounted and displayed in the College exhibit, with analysis of each kind.

A set of wheat samples, cut at intervals of 24 hours, beginning with the earliest formation of the berry and extending to complete dead-ripeness—forty-six samples in all—were mounted and displayed in glass show bottles in the Michigan division in Agricultural Hall. The progressive changes of the grain from day to day and the successive changes in the chemical composition could thus be seen at a glance. Bulletin 101 showed the changes, not only in the grain, but in the straw, so that the farmer could trace the history of the wheat plant from flowering to dead-ripeness. This bulletin was given out to all who desired. In the same exhibit were shown the leading kinds of Indian corn raised in this State, with labels showing the chemical analysis.

AMERICAN ASSOCIATION OF OFFICIAL AGRICULTURAL CHEMISTS.

I attended the meeting of this association in Chicago and participated in its discussions, reading a paper on methods of soil analysis. It is the office of this association, made up of the chemists of the experiment stations of the United States, to prescribe the methods of analysis of fertilizers, food products, etc., of this country.

While in Chicago I also attended the World's Congress of Medical Jurisprudence and read a paper on determining the line that force was applied in the fracture of glass, to determine, for example, whether a glass lamp was exploded or broken by external blow.

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ANALYSIS OF FORAGE PLANTS.

Analysis has been made of the new forage plant *Lathyrus Silvestris* to determine its capacity as stock-food; also of spurry, and of peppermint hay, or the residue after extracting peppermint oil. These will all be found in Bulletin 101.

An investigation was made to determine the food value of oat straw at different periods of growth. A sample was cut at the same hour daily for 30 days—from the time when it first headed out to complete ripeness. This examination developed interesting facts, but the results have not been given to the public.

ANALYSIS OF CHEESE.

The wide range in quotations of cheese in the Detroit market led to the inquiry whether the difference in price was in consequence of difference in quality and real value, or was the whim of the consumer.

By the kindness of Robert Gibbons, of the "Michigan Farmer," I obtained specimens of Michigan, Canadian and New York cheese, all of which were analyzed, and the results published in the "Michigan Farmer." The season was too far advanced to get entirely satisfactory samples, and the work will be resumed another year. I can see no good reason why Michigan cheese should not hold its own with the cheese of any neighboring state or province. We have the milk of first quality, and must have cheese equal to the best. It is a shame that we import cheese and do not make our own, and hold the market against all comers.

METEOROLOGICAL OBSERVATIONS.

The meteorological observations have been taken at the College for more than 30 years, and form the most complete and continuous record to be found in this State. The value of such records increases with the years, and it would be a misfortune to break the continuous record. These have been carried on for the year past, and include tri-daily observations with the wet and dry thermometer or psychrometer, the open air temperature, the direction and force of the wind, the kind and percentage of clouds, daily records of maximum and minimum temperatures, amount of sunshine, the sun temperature of a thermometer in vacuum, and record of rain, aurora, etc.

Observations have also been taken for a part of the year of temperature of the soil at different depths, both in the open field and in forests, the temperature of interior of trees in like positions. Much of this is yet to be printed.

COMMERCIAL FERTILIZERS.

The law requires the chemical analysis of all commercial fertilizers sold or offered for sale in this State, if the retail price of the fertilizer exceeds $10 per ton. In 1893 fifty-seven fertilizers were gathered in the open market and analyzed, and the results published in July, 1893, in bulletin 97. In 1894 the fertilizers gathered and analyzed were nearly eighty, and the results of the analysis will appear in the bulletin now passing through the press.

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One effect of this systematic inspection of fertilizers offered for sale in our State, has been to drive out the shams and frauds offered for sale; the quality of the goods in the market has been improved. The honest manufacturer has thus been protected from dishonest competition, and the farmer has been protected from frauds.

SEARCH FOR POISONS.

The chemist is often called upon to determine the presence and kind of poisons in cases of sudden and mysterious deaths of persons or animals. A remarkable case of the latter kind was brought to my notice last winter. In January I received a letter from a leading farmer in Riga, Mich., saying he had lost three valuable cows that showed symptoms of poisoning, the cows having been fed with chops (corn, oats and wheat ground together) and wheat bran from Toledo. At my request, some of the ground feed, or chops, and wheat bran were sent for analysis. The chops were free from poison, but the wheat bran contained an astonishing amount of white arsenic, the grains of arsenic being visible to the naked eye, and some of the sifted bran contained more than two per cent of arsenic.

Some of the stomach and contents of one of the cows was sent for analysis, and enough arsenic found to account for the sudden deaths.

These facts about the poisoning of his cows were placed before the farmer, and he was urged to investigate how so large an amount of poison could be in the bran, and find who was poisoning his stock. He replied that he had no suspicions of any one of poisoning his cows, but thought that the arsenic was scattered about the mill to kill rats and mice, and then carelessly swept up with other material and mixed with the bran.

Early in April I got another letter saying he had just lost two colts and a cow with symptoms of poisoning, and sent sample of the ground feed he had given his stock. Analysis of this showed the presence of arsenic. This fact was reported to the farmer, and nothing more has been heard from him. A large amount of work was done for him for nothing, and no benefit seems to have come from it because the case was not thoroughly investigated in Riga. It seems that some thorough detective work is needed on this case. The matter was laid before the Live Stock Commission, but their work lies in the line of contagious and epidemic diseases.

Other cases for investigation in suspected poisoning have come to our notice, but none with such peculiar conditions as these from Riga.

FARMERS' INSTITUTES AND OTHER GATHERINGS.

In November, 1893, I attended a meeting of the Highland Farmers' Club to listen to a discussion of the question "What has the Agricultural College done for the farmers?" where I was courteously offered opportunity to explain some of the work of the chemical department for the benefit of agriculture.

By invitation I attended the meeting of the Kalamazoo County Farmers' Club, in Schoolcraft, and spoke of adulteration of foods for man and beast, exhibiting some of the striking samples of food adulteration for the table and the stable. I also attended the annual meeting of the State Horticultural Society, and of the Eaton County Agricultural Society, in

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Charlotte, where I called attention to the danger to the fruit interests by adulteration of vinegars and fruit jellies.

Of the series of Farmers' Institutes for 1894, I attended the Institute at Highland, where a very interesting and profitable meeting was held.

The Adjunct Professor attended three "long Institutes" of four days each, at Grand Ledge, Battle Creek and Coldwater, and three short Institutes at Allegan, Sparta and Alto.

Of the assistants in the Experiment Station, Mr. Rossman attended the Institute at Greenville, and Mr. Harrison the Institutes at Stockbridge, Highland, Grand Ledge and Coldwater.

WINTER WHEAT FOR MICHIGAN.

The College has always stood ready to do battle for the farmers in defence of valuable varieties of wheat to be grown in our State, as the memorable struggle over Clawson bears witness. It is equally ready to seek out new varieties of greater promise for the farmer and the miller.

Michigan is distinguished as the home of the white winter wheat. The red and amber winter wheats are grown in great perfection, but no State can excel ours in the production of white winter wheat. When we remember that two million acres are yearly sown to winter wheat in Michigan, and consider what the results would be of introducing a variety of wheat that will produce three to five more bushels per acre, and increased price of even five cents a bushel, we begin to measure the importance of this question of better and more prolific varieties of wheat for our State. It is a discouraging time to boom wheat-growing when good wheat sells for fifty cents a bushel. Men remember the words of old: "Man shall not live by bread alone," and it is certain that the farmer shall not prosper by wheat alone! Yet "bread is the staff of life" and the farmer cannot abandon the wheat crop. If wheat is to be raised in such times of depression, then there is the greater reason for the better kinds that will command higher prices. The wheat question today overtops, in importance, blooded stock and high grade wool.

The chemical department accordingly has kept an eye out for the best and most prolific varieties of winter wheat, suited to the soil and climate of Michigan. By extensive correspondence six varieties of winter wheat have been found that are full of promise for Michigan wheat growers. In the experimental plats in other states they have produced from 34 to 41 bushels per acre. It is not expected that in ordinary field culture they will produce as much, but if they will raise the acreage product even two bushels, the aggregate would be most beneficial for our State.

These wheats have succeeded in other states, but we do not *know* that they will be as successful here, and it would be unfortunate to spread through our State a variety of wheat which would fail here because of some difference of soil or climate. It is proposed, therefore, with the coöperation of the farm department, to give these varieties a trial by field culture, and thus be assured of their adaptedness to our State before sending them out to the farmers. Several acres will be devoted to this trial.

All of these wheats look very promising; the berry is of good size and very uniform, and they delight the eye of the miller. Yet the value of the flour for the baker and the consumer demands consideration. The whole wheat will be analyzed; also the flour made from the separate wheats. Then the flour will be tried by all the recognized methods—the gluten

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test and the vesiculating quality, that were used in the Clawson wheat trials in 1877. The aleurometer (gluten measurer) of M. Boland of France, and used by the millers in our country, has been ordered for this trial, and is now on its way to the College. Also the more satisfactory apparatus of L. C. Porter of Minneapolis; also the farinometer of Kunis of Leipzig, and the viscometer of Prof. Jago of Brighton, Eng. The flours of each of these kinds of wheats will be separately tested by all these means before the wheats are sent out to the farmers. By such means the College hopes to be a benefit to our farmers.

CLASS-ROOM WORK.

The work in class-room and laboratory work, while attracting less notice from the public, is, after all, the most important to the school, and indirectly to the public. The teacher who slights his classes to make a spectacular display before the public, is worth little to any college.

With classes in sophomore, junior and senior classes, with many special students in chemistry, and a large attendance of summer students, the chemical department is kept busy for the entire college year. The kind of work, and the nature of the class instruction has been given in former reports, and need not be repeated here.

WORK IN EXPERIMENT STATION.

Much of the work in the chemical department of the Experiment Station has already been given in the body of this report. The complete analysis of seven kinds of wheat may be mentioned in addition. The amount of work required in different investigations is more than the public would suppose. For sample, 385 separate estimations in the analysis of fertilizers, 360 in the analysis of wheat, 300 in the analysis of oat straw, etc., etc. In analyses for the American Association of Official Agricultural Chemists to settle upon the best methods of analysis, 45 estimations of potash, 42 of moisture, 12 of nitrogen, etc.

In coöperation with the dairy work of the farm department, a large number of analyses of butter, cream and milk. The cordial coöperation of the farm and chemical departments in matters relating to both in the College work is an omen of good.

All of which is respectfully submitted.

R. C. KEDZIE,
Professor of Chemistry.

FRANK S. KEDZIE,
Adjunct Professor of Chemistry.

AGRICULTURAL COLLEGE, MICH.,
June 30, 1894.

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REPORT OF THE DEPARTMENT OF BOTANY AND FORESTRY.

To the President:

SIR—I submit my report for the year closing June 30, 1894:

During the year students have received instruction in botany as follows:

Freshmen in structural botany, twelve weeks, three lessons per week	54
Sophomores in systematic botany, six weeks, daily	41
Sophomores in systematic botany, two hours a week for twelve weeks	30
Sophomores in physiological botany, twelve weeks, daily	30
Seniors in parasitic fungi, twelve weeks, daily	6
Summer students in short course, two to eight weeks, daily	13
Students of dairy course, fifteen lessons	22
Students in mechanical course, three hours per week for twelve weeks	17
Sophomores in the the study of grasses, four days per week for six weeks	32
Seniors in weeds or grasses	3
Resident graduates for one to three terms	5
	253

In Harvard University in 1891, where there were in all about 2,500 students, a little less than 300 received instruction in botany, but of course, many of them were much farther advanced than at this college. This is to show that we have comparatively a good many students in botany, even though the College is not very large.

THE HERBARIUM.

The additions for the year have been less than for some years past. A special effort has been made with moderate success to procure desiderata. Our efforts to make an exhibit at the World's Fair prevented us from accomplishing as much as usual in collecting near home.

A special feature of the collections made during the year consisted in pressing grasses, other forage plants and weeds at full length and in sewing specimens of each species two feet wide to thick Manilla paper. These are of much use at Farmers' Institutes and for classes at the College and they can be transported from place to place much handier than bundles or bunches.

We have been particularly fortunate in keeping out insects. I doubt whether a single one can be found in the entire collection.

There have been added the past year the following plants:

C. F. Baker, Colorado	96
S. H. Camp, Colorado and Michigan	97
Miss E. J. Cole, grasses	25
A. H. Curtiss, Florida	85
H. Eggert, Missouri	111
O. A. Farwell, Detroit	76
M. L. Fernold, Maine	220

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Rev. J. Fowler, Canada	240
Harvard University	200
A. Heller, East Tennessee, etc.	32
Mrs. Herrick, California	1
T. H. Kearney, Jr., Southeastern Kentucky	259
Alven Nelson, Wyoming	50
Phil. Academy of Science, Greenland	60
A. J. Pieters, Lake St. Clair	22
Miss C. F. Price, Kentucky	13
C. G. Pringle, Mexico	253
J. H. Sandberg, Desiderata	383
G. D. Sones, California	203
W. N. Suksdorf, Washington	233
J. W. Toumey, Arizona	86
S. M. Tracy, Mississippi	200
U. S. Department of Agriculture	271
R. S. Williams, Montana	50

Home Collections.

Jackson	30
Wheat	30
Oats	60
Grasses, weeds, etc., on large sheets	220
Other plants	100

Mosses.

J. Macoun, Canada	70

Lichens.

J. Macoun	80
Cummings and Seymour	70

Fungi.

J. B. Ellis	200
C. L. Shear, New York	100
Sydow, Europe	100
	6,323

THE BOTANIC GARDEN.

This continues to be much frequented during the growing season, and many are the favorable comments on its unique and neat appearance. Former reports have contained considerable on this subject and, as in my next report I hope to present a very full statement, in this I shall say but little. Land has already been prepared on both sides of the brook in the ravine from the older portions of the garden to the road near the Physical Laboratory. This new portion will be planted the present season.

As a portion of this garden, we may very properly include the patches of grasses, other forage plants and weeds, some 250 in number. These

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occupy about an acre of land between Well's Hall and the boiler house. All of the garden is much frequented by students, and is of especial value in supplying materials for use in the botanical laboratory.

THE ARBORETUM.

The trees continue to grow, and the oldest have been planted since the spring of 1875, a period of nineteen years. We have recently printed new labels for all the species. There are many interesting lessons to be gleaned from this plat of less than two acres, and the longer the trees stand the more valuable will they be for study by those interested in forestry.

THE WORLD'S FAIR.

My last report contains lists of objects exhibited by the botanical department. No other college or state exhibited so many photographs of American and foreign botanists as did M. A. C. There were shown on swinging frames 152. We have since obtained 40 from Germany, while the next in extent was the one made by the coöperative exhibit of agricultural colleges and experiment stations. This contained photographs of 34 American and 48 foreign botanists.

As can be seen by consulting the inventory of this department, we obtained considerable material from the forestry exhibit made by the State, chief of which were five very large planks of white pine, some 40 logs four feet long, nine knots, six large natural grafts, a deer's antler nearly grown over by a tree, some large splendid veneers, three bunches of extraordinary shingles, specimens of paper pulp, 22 panels of wainscotting, a lot of excelsior.

The agricultural school of Grignon, France, presented 27 photographs of sections of stems of plants, four of their garden and laboratory, 100 of typical trees, each of a different species.

PHOTOGRAPHS.

While at the Fair, I took especial pains to study the photographs in the exhibits, especially those illustrating botanic gardens, trees, growing crops in foreign countries, foreign vegetation in general, fruits and the like. From notes taken at Chicago, I have been able to prepare valuable lists, and recently have purchased from California 62 views, chiefly of trees and lumbering; from Jamaica nine large views; from Singapore 45, and a few from several other countries.

MISCELLANEOUS.

My winter vacation was only such in name, not in fact. Nearly four weeks were occupied in attending Farmers' Institutes and two meetings of the State Horticultural Society. After New Year's, the dairy school was in session for six weeks. I taught these students something regarding pastures and meadows and weeds, also instructed them in the use of a compound microscope, showed them some of the common molds and bacteria found in connection with milk and butter, also butter and milk in

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various stages. The lessons were not numerous, but they came scattering along two or three a week. In case of the use of the microscope, a good deal of personal attention was given to the preparation of materials and getting apparatus ready for the class. This I did myself, as the assistant in this work was excused the whole of his vacation.

I took part in the college section of the State Teachers' Association, meeting twice with the general committee on program, and served as chairman of the section.

Much time has been spent with those who were at one time students at this College, in answering numerous inquiries regarding a great variety of topics, from writing recommendations to giving all the hints possible for making a county fair attractive and profitable.

For six months a good deal of attention has been given to gathering the addresses and present occupation of some two thousand five hundred students, more or less, who were at some time in attendance, but who left without completing a course for a degree.

Recently the preliminary steps have been made for organizing a State Academy of Sciences. The leading objects will probaby be to study the flora, fauna and other natural features of the State—to divide the work and begin a systematic survey of the State. At present, the following officers serve in the organization:

Dr. W. J. Beal, president.

Dr. J. B. Steere, vice president.

Dr. F. C. Newcombe, secretary and treasurer.

Prof. W. B. Barrows and Prof. I. C. Russell, other members of the executive committee.

Last winter another of my assistants, G. H. Hicks, was the successful candidate for a position in the United States Department of Agriculture. He passed the highest examination for the position, where he is to study the subject of seeds, botanically and agriculturally, making a large collection to aid in identifying specimens sent for name. Mr. Hicks is a very earnest, enthusiastic, and successful student, and I have no doubt that he will fill his new position with excellent satisfaction.

DONATIONS.

From Robert Douglas & Sons, Waukegen, Illinois:
Cones of *Picea Engelmanii.*
P. Breweriana.
From Prof. J. W. Toumey, Tucson, Arizona:
86 specimens of Arizona grasses.
Seeds of a new *Juglas*, a *Cactus*, *Rumex*, and a *Fraxinus.*
From Prof. L. H. Pammel, Ames, Iowa:
2 roots of *Polygonum Sachaliense.*
From Mrs. H. W. Hicks, Munith, Michigan:
9 lots of *Carya microcarpa.*
From P. B. Woodworth:
Photograph of *Tillandsia* on dead trees in Florida.
From Warren H. Manning, Brookline, Mass.:
A living plant of *Cornus stotonifera aurea.*
From C. Skeeles, Grand Rapids, Mich.:
Section of large grape vine and several living native plants for the botanic garden.
From J. H. Redfield, for Phila. Acad. Nat. Sci.:
About 60 species of plants for the herbarium, collected by Meehan in Greenland.
From C. A. Whittemore, curator Kent Scientific Institute, Grand Rapids:
38 species of seeds from Algeria.

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GIFTS TO OTHERS.

To State Normal School, Miss Lucy A. Osband in charge of botany:
100 herbarium specimens of carices.
200 herbarium specimens of grasses.
To the U. S. Department of Agriculture, F. V. Coville in charge of botany:
360 herbarium specimens of wheat, each a distinct race, with few exceptions.
100 lots of seeds of authentically named weeds and grasses.
To Prof. L. H. Bailey, Ithaca, N. Y.:
61 lots of roots of sedges.
6 lots of roots of *Compositæ*.

Small numbers of other things have been donated from time to time to others, and numerous exchanges have been made.

I again tender my thanks to Mr. C. F. Wheeler for valuable services in rendering the department useful, especially in his efforts to perfect the herbarium and in extending the botanic garden. He has taught some of the classes acceptably, and has taken part at Farmers' Institutes.

B. O. Longyear has also made a fine beginning during a term and half as instructor.

I am yours very truly,

W. J. BEAL,
Professor of Botany and Forestry.

AGRICULTURAL COLLEGE, MICH.,
June 30, 1894.

REPORT OF DEPARTMENT OF ZOÖLOGY AND PHYSIOLOGY.

To the President:

SIR—I have the honor to submit the following report of the Department of Zoölogy and Physiology, covering that part of the current year from February 20, when the department was put in my charge, to and including June 30, 1894.

During the spring term the classes were, as heretofore, junior, Physiology five lectures per week and twenty-four hours of laboratory work; and senior, Geology (elective) five lectures per week. Thirteen students took the course in Geology, one other dropped out on account of sickness, and another was passed on special examination. The class in Physiology consisted of thirty-three members, and one additional student was passed by special examination. It did not seem advisable, with the latter class, to deviate materially from the course followed with previous classes; but circumstances necessitated a modification of the usual course in Geology and more time was given to the dynamical than to the historical branch of the subject. In future, at least one lecture per week will be replaced by two hours of laboratory or field work.

During the summer term the time was fully occupied with Entomology and the subject was taught much as heretofore, except that it was deemed best to give the twenty-six juniors a double amount of laboratory work in place of one lecture per week omitted; they accordingly spent nearly forty-eight hours in the laboratory, and with excellent results.

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The efficiency of the department could be much increased by the purchase of suitable charts and diagrams, illustrating typical structures, both zoölogical and geological; entomological charts are particularly needed. It is true most of them can be made in the department, but not economically or without some neglect of other work. The purchase of one or more good compound microscopes and the necessary accessories is also a matter of great importance; with the exception of a single dissecting instrument the department does not own a good microscope of any kind.

It seems to me very desirable that a radical change be made in the janitor work for the department. Most of the work as now done is necessarily imperfect and unsatisfactory to all parties. It is neither instructive nor elevating to the student, while work which is both is abundant and sorely needs attention. Following the completion of the electric road, which now connects the College with Lansing, a great change has taken place in the number of visitors to the College, and particularly to the museum, and the number of such visitors is sure to increase each year. This necessitates additional labor in caring for the museum, and if this work is thrown upon the regular student janitor no time whatever is left him for instructive work. I earnestly recommend that a competent janitor, who is not a student, be regularly employed for all such work and that, so far as funds are available, students be employed to do work of a higher grade in the laboratories and museum.

GENERAL MUSEUM AND COLLECTIONS.

Before the advent of warm weather the entire insect collection was carefully examined for museum pests, thoroughly treated with bisulphide of carbon and each box supplied with naphthaline cones. Considerable work has been done on this collection during the season, many species have been added, and the collection of duplicates has been largely increased. One assistant could be employed profitably all the time on this collection.

The general museum has received little attention thus far, beyond the care absolutely necessary to prevent loss or deterioration. The collections are large and valuable, but with the exception of insects no branch of the Michigan fauna is represented by anything like a full collection. With the coöperation of the Alumni, now well scattered throughout the State, and especially with the impetus given to the study of our resources by the recent organization of the Michigan Academy of Science, it should be an easy task to very greatly augment our collections of zoölogical, geological, archæological and mineralogical specimens. The cases are already overcrowded and what little case room remains in the museum and laboratories will soon be occupied. Two new cases have been planned already for the museum, and will be built at once; also a case for the lecture room, for the storage of illustrative material in teaching. This will relieve somewhat the crowded condition of the museum, but only temporarily, and the provision of increased room for collections cannot long be delayed.

Respectfully,

WALTER B. BARROWS,

Professor of Zoölogy and Curator of the General Museum.

AGRICULTURAL COLLEGE, MICH.,
June 30, 1894.

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REPORT OF THE DEPARTMENT OF ENGLISH LITERATURE AND MODERN LANGUAGES.

To the President:

SIR—I have the honor to submit as my report for the year ending June 30, 1894, the following statement:

My report published in the last (1893) volume of the reports of the Secretary of the Board of Agriculture covers the time of the present year up to and including the fall term of 1893. I include in the present statement, therefore, only the spring and summer terms of 1894.

The amount of work done during these two terms has been the same in number of classes and character of work as in previous years, with the exception that I have carried a French class through the two terms in addition to the classes named for the spring and summer terms in my last report.

There has been no material change in the interest displayed by students in their work in this department. The work is cheerfully done, and, taking into consideration our extremely low entrance requirements, the results are all that could be expected.

During the summer term of 1894, the complications that arose in connection with the commencement exercises gave me much and serious uneasiness. I sincerely congratulate the College, however, on the success which the plan finally adopted met with. The exercises went off smoothly, the people were interested, and the compliments from every side were evidence that the right policy had been pursued. I shall try, in the course of the coming vacation, to elaborate carefully a permanent plan for our commencement exercises.

I find, each year, increasing difficulty in getting the oration work done at the proper time. Students, and good students too, allege that changes in the course and additions to it keep them constantly busy in attending to the daily routine of work and leave no time for reading and thought. This, it seems to me, is a matter that should be carefully considered in all future deliberations concerning modifications of the course. As long as students are admitted to our courses with crude and insufficient preparation in the branches of a common school education, a large part of our time must be taken up in making good these deficiencies, and any curtailing of the work in the English department must be regarded as a calamity.

Very respectfully submitted,

HOWARD EDWARDS,
Professor of English and Modern Languages.

AGRICULTURAL COLLEGE, MICH.,
June 30, 1894.

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REPORT OF DEPARTMENT OF MATHEMATICS AND CIVIL ENGINEERING.

To the President:

SIR—The year past, one term of which was finished under the administration of your predecessor, has been an exceptionally busy one. Many more hours of teaching have been done, and considerably more practical engineering in designing and construction than in any other year since the department came under my supervision. I have the honor to submit the following report of the year's work:

The personnel of the department has again suffered change. At the beginning of our school year, in August, 1893, Professor McNair accepted the chair of mathematics and physics at the Michigan Mining School. The lever of increased salary is a strong one and will probably continue to disturb our plans in future as it has in the past. Professor McNair's incumbency of nearly two years has been marked by success for himself and profit for this department and the College. The vacancy caused by his withdrawal was supplied by the promotion of Instructor W. Babcock, Jr., to be assistant professor of mathematics. Mr. J. N. Hatch was appointed instructor. These gentlemen have shared with me the work of instruction of the year.

INSTRUCTION.

Our first duty is with the teaching, a full share of which is assigned to the department. The following statement of classes met exhibits the division of this work in the different terms:

Summer term, 1893. Seniors, one class in civil engineering and one class in agricultural engineering. Juniors, one class in mechanics of engineering. Sophomores, one class in differential calculus, one class in plane trigonometry, and one class in surveying, with afternoon practice in the field. Freshmen, two classes in plane geometry and two classes in solid geometry. Total enrollment in these classes, 197.

Fall term, 1893. Seniors, one class in graphic statics. Juniors, one class in integral calculus. Sophomores, one class in trigonometry and two classes in solid geometry. Freshmen, three classes in algebra. Total enrollment, 180.

Spring term, 1894. Seniors, one class in civil engineering with afternoon practice in the field. Juniors, one class in mechanics of engineering. Sophomores, one class in analytic geometry and one class in surveying, with afternoon field practice. Freshmen, two classes in geometry and four classes in algebra. Total enrollment, 218.

Besides the regular classes named above, a special class in astronomy was formed in the summer term of 1893 to accommodate several summer students applying for instruction in that subject. During the three terms covered by this report 208 special examinations have been given and reported. Some of these were for admission of the students to advanced standing, some to make up back work. To answer other questions connected with the work of instruction the following tabulation has been prepared:

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Class work of the department of mathematics and civil engineering for the year 1893-94, beginning May 22, 1893, and ending May 11, 1894.

Class.	Term.	No. of divisions.	No. of hours per week for each division.	Total No. of hours per week for the class.	No. of students enrolled.
Freshmen, Plane Geometry	Summer	2	5	10	51
" Solid "	"	2	5	10	32
" Algebra	Fall	2	5	10	85
" "	Spring	3	5	15	109
" Plane Geometry	"	2	5	10	44
Sophomores, Plane Trigonometry	Summer	1	3	3	25
" Surveying	"	1	4	4	35
" Differential Calculus	"	1	5	5	16
" Trigonometry	Fall	1	5	5	34
" Solid Geometry	"	2	5	10	42
" Analytic Geometry	Spring	1	5	5	27
" Surveying	"	1	4	4	25
Juniors, Mechanics of Engineering	Summer	1	5	5	11
" Integral Calculus	Fall	1	5	5	10
" Mechanics of Engineering	Spring	1	5	5	9
Seniors, Civil Engineering	Summer	1	6	6	13
" Agricultural Engineering	"	1	5	5	4
" Graphic Statics	Fall	1	3	3	9
" Civil Engineering	Spring	1	7½	7½	4
Totals		30	87½	117½	595

EQUIPMENT.

Not very much has been added this year in the way of apparatus, but a few instruments of the best quality have been purchased and are being used in class and field work. Among these may be mentioned a set of drafting instruments of the first class, a protractor of precision, a pedometer, a prismatic compass, two Locke levels, a beam compass, three rod levels, a compensated tape, a New York rod and several common tapes. Of $354 actually spent by us, nearly $100 were applied to the purchase of books for the general library.

My office has received a much needed coat of paint and paper and there have been added to the office furniture a small filing cabinet and some chairs. In this connection I would suggest that field work in surveying would be much facilitated if there could be provided a separate room for the reception of our instrumental equipment, where transits, compasses and the like might be left for a time upon their tripods without danger of injury from dust or falls. At present my office is the only room available for the purpose, an arrangement neither economical nor convenient.

PRACTICAL ENGINEERING.

The first work of the year in practical engineering consisted in planning and superintending the construction of drains at "Howard Terrace." Provision for removing all excess of water from the basement and roof of this structure was supposed to have been made at the time of building it. But for several years rains had flooded the cellars and left a condition of things neither comfortable nor healthful. To remedy this, drains of unglazed tile were laid outside of and along three sides of the building, and also the cellar floors. By connecting the roof conductors and over-

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flow cistern pipes to the sewer, all excess of roof water was disposed of. This work was done in September, 1893. At the time of making this report, residents of the building were questioned as to the efficiency of the means adopted for drainage and all agreed in testifying that there had been no trouble from water since the drains were completed. I may add that the location of these drains and their grades, sizes, etc., were carefully mapped for future reference.

A special legislative appropriation of $1,000 for the construction of sewers, became available this year. As mentioned in my report of last year, there had been prepared by this department plans of a system of separate sewerage providing for such residences of the faculty as were not already supplied with sewerage facilities, and several of the main college buildings. The matter of construction was placed by the board under the direction of the President and Secretary, who adopted the plans as submitted. The surveys, superintendence and records occupied some of the time of members of this department during the fall term. The work of construction was begun September 18 and finished November 15, 1893. A brief description (not a bill of survey) of the lines of the system follows:

Beginning at the outlet at the river bank, about 180 feet westerly from the mouth of the ditch through the wild garden, a straight line of 8-inch main extends 589 feet to a man-hole at the foot of the south slope of the road embankment near the northwest corner of the chemical laboratory. Into this main empty 6-inch laterals from the chemical laboratory and Abbot hall. From the man-hole above mentioned the main is continued with 8-inch pipe 376 feet in another straight line to a second man-hole just west of the outlet of the 18-inch tile drain discharging at a point northeasterly from Abbot hall. From this man-hole two lines of 6-inch pipe proceed; one connecting with a sewer laid at an earlier date and previously discharging into an open ditch at the outlet of the 18-inch tile drain mentioned, the other extending in a straight line 434 feet to a man-hole about 45 feet south of the building now occupied by the unmarried members of the faculty. From this last man-hole run two laterals of 6-inch pipe, each consisting of two straight lines of pipe, along the rear of the faculty residences. These are denominated in our records the east and west branches, and each terminates in an automatic Van Vranken flush-tank supplied with water from the college water system. The east branch, 306 feet long, ends at the northwest corner of the residence of the professor of horticulture and the west branch, 443 feet long, ends at the northwest corner of the residence of professor of mechanical engineering. Service laterals of 4-inch tile were run to all residences along the branches, and to College hall. Also a 6-inch connection was made to the existing sewer from "The Terrace." Extra Y-branch sections were laid at intervals to provide for future possible service connections. Finally, matters of location, and grades and all other items likely to be called in reference were reduced to forms of permanent record, and in the shape of maps and accompanying explanations are now on file in my office.

In the spring term of 1894, a plan for a hospital building was submitted by this department, received the approval of the board and work was at once begun on the construction. The staking out of foundation lines for this building, extension of the sewer and water lines to it, grades and staking out of the foundry and the hennery, measurements for preliminary estimate of the cost of cement walks and the drainage of Bachelors' hall are

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a few of the lesser items of surveying work in which the department has made itself useful.

In January, 1894, I attended one institute at Battle Creek and gave a talk on "Roads and bridges."

Respectfully submitted,

H. K. VEDDER,

Professor of Mathematics and Civil Engineering.

AGRICULTURAL COLLEGE, MICH., *June 30, 1894.*

REPORT OF THE DEPARTMENT OF VETERINARY SCIENCE.

To the President:

SIR—I herewith beg to submit a report of the work done in the veterinary department during the year 1893–4.

In July, 1893, I completed the work of installation of the veterinary alcove in the coöperative exhibit of the agricultural colleges and experiment stations of the United States, at the Columbian Exposition. The following month I again returned to the exposition for the purpose of studying the external conformation of different breeds and classes of horses in connection with a bulletin which was in course of preparation, and has since been issued. A new class began the course of veterinary with the autumn term of 1893, consisting of fourteen seniors and two specials.

The course of instruction during this term was devoted to the anatomy of such domestic animals as the horse, the ox, the sheep and the hog.

During the last two weeks of the term we spent two hours a day in the dissecting room studying, through actual dissection, those parts and organs which had previously been described in the class room.

During the winter vacation I issued a bulletin upon the External Conformation of the Horse, attended those farmers' institutes which I was assigned to, and delivered addresses at veterinary associations.

During the spring term of 1894 our class room work resumed with the study of the external diseases of the horse and other domestic animals.

The summer term was devoted to a description of the internal diseases which affect animals.

During the spring and summer terms one day in each week was devoted to a description of some drug or drugs used in the treatment of disease; in this manner about 120 articles of *materia medica* were discussed.

During the year our course of instruction received much valuable material from outside sources through animals being brought to the laboratory for treatment which in many instances enabled us to apply the teachings of the class room in a practical and interesting manner. I also attended to the veterinary requirements of the stock in the horticultural and agricultural departments.

As State veterinarian I visited many parts of the State and investigated reported outbreaks of contagious diseases among the live stock.

I am sir, yours obediently,

AGRICULTURAL COLLEGE, MICH., *June 30, 1894.*

E. A. A. GRANGE,

Professor of Veterinary Science.

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REPORT OF THE DEPARTMENT OF DRAWING.

To the President:

SIR—The following is the report of the department of drawing for the college year, 1893–4:

FALL TERM, 1893.

Freshman mechanicals in mechanical drawing; two hours, four times per week—eight hours.

Sophomore mechanicals in descriptive geometry; one hour five times per week.

SPRING TERM, 1894.

Freshman agriculturals in freehand drawing; two divisions, two hours each—twenty hours.

Freshman mechanicals, machine sketching; two hours, three days per week—six hours.

SUMMER TERM, 1894.

Freshman mechanicals in descriptive geometry; two divisions, five hours each—ten hours.

During the greater part of this term two hours per day were devoted to work with special students in freehand drawing.

The Board of Agriculture having very kindly extended my winter's leave of absence to the middle of the spring term, I was not present to take up my usual work in free hand drawing and machine sketching, but the classes in the former subject were organized and conducted very efficiently by Mrs. Ella M. Kedzie, late art teacher at Olivet College, while Mr. Westcott of the mechanical department kept the freshman mechanicals busy in machine sketching and drawing.

At the beginning of the sixth week of the term, very much benefited by my extended leave, I resumed work.

A few good casts were added to our collection in the drawing room during the spring term.

Models for illustration in descriptive geometry and mechanical drawing are very much needed.

With the growth of the summer school and the completion of the street car line, the number of students taking special work in drawing and work that may be more properly termed art study than that followed heretofore is likely to increase.

The literature in our library that may be properly said to come in this department is very meager. I would suggest the placing of a portion of the library fund at the disposal of this department.

Faithfully,

W. S. HOLDSWORTH,

Ass't Professor of Drawing.

AGRICULTURAL COLLEGE, MICH., *June 30, 1894.*

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REPORT OF THE DEPARTMENT OF POLITICAL ECONOMY.

To the President:

SIR—I have the honor of submitting the following report concerning the work done in the department of History and Political Economy during the year 1893–94.

In the autumn term of 1893 I met the agricultural part of the freshman class, divided into two sections, in English history five times per week during the whole term. The text-book used was Montgomery's History of England, used in connection with outside reading. During the same term the agricultural sophomores recited to me in Psychology four times per week, using Steele's treatise on this subject as a text-book. The agricultural juniors, using Janet's text-book, recited to me in Ethics during the last part of the same term.

The spring term of 1894 was occupied mostly with seniors, ten of whom elected Political Economy, and thirteen together with some juniors formed a class in Logic. Walker's text-book, supplemented by some lectures, was the basis of work in the first class, Swan's Treatise on Logic in the latter.

During the summer term I met a class of seventeen seniors in the Constitutional History of the United States. Very much collateral reading was done by this class, Hildreth's, Schouler's and McMaster's Histories of the United States, and Bryce's American Commonwealth, being used for reference books; Johnston's American Politics and Fisk's Civil Goverment of the United States as text-books. Another class, eight seniors, elected Psychology during this term, using McLellan's text-book.

Outside the class room some time was given during the winter to preparation and delivery of a lecture at a Farmer's Institute, held at Greenville.

Very respectfully,

WILBER O. HEDRICK,

Ass't Professor of History and Political Economy.

AGRICULTURAL COLLEGE, MICH.,
June 30, 1894.

REPORT OF THE LIBRARIAN.

To the President:

SIR—I have the honor to present the following report on the library for the year ending June 30, 1894:

The growth of the library has been as follows: Bound volumes—by purchase, 803; donations, 110; from the bindery, 124; total additions, 1,037. Number of bound volumes in the library, 16,658. Unbound volumes and pamphlets—by purchase, 19; by gift, 244; total, 263. Whole number in the library, 4,405.

Bound volumes have been received as follows:

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The Botanical Department—19 vols.
Brownless, A. C.—Calendar Melbourne Univ., 1894.
Burpee, W. A.—Injurious Insects. Sempers.
Canada—Agr'l Report, Ontario, 1892.
Legislative Assembly, 1.
Council, 1.
Sessional Papers.
Cook, Prof. A. J.—Birds of Michigan.
Heath, D. C. & Co.—Guide to Study of Common Plants. Spaulding.
Illinois Hort. Soc.—Trans., 1893.
Kansas Academy of Science—Trans., vol. 13.
Lintner, J. A.—Injurious and Other Insects of N. Y., 8th, 9th reports.
McClurg, A. C. & Co.—Gothic Grammar. Braune.
Nature of Mind and Human Automatism. Prince.
Mass.—Agriculture, 1893. Sessions, Wm. R.
Index to Agr'l Reeorts, 1837-1892.
Michigan Reports:
Agriculture, Report of State Bd., 1892.
Attorney General, 1892-93.
Farm Statistics, 1891-2, 1892-3.
Inspector of Factories, 1st annual report.
Legislature, Local Acts, 1893.
Senate and House J'ls, 16 v.
Michigan and its Resources, 1893.
State Medical Soc., Trans., vol. 17.
Supt. Public Instruction, 1892.
Supreme Court, reports, vols. 93, 94.
Missouri Hort. Society—Report 1892.
Pettigrew, J. A.—Report Commissioners of Lincoln Park, Chicago, 1886-1892.
Reynolds, H. G.—British Agriculture. Donaldson.
Le bon jardinier.
Shelton, E. M.—Hand Book Australian Fungi. Cooke.
Smithsonian Institution:
Report, 1892.
Bureau of Ethnology, 9th, 10th, 11th annual reports.
Contributions to Knowledge, vol. 28.
Miscellaneous Collections, vols. 34, 36.
U. S. Nat. Museum, Report 1891.
Standish, Mrs. Cornelia—Century Mag., 4 vols.
Stout, Hon. B. G.—12 vols.
Strange, Daniel—Farmer's Tariff Manual.
Strong, C.—Report City of Kalamazoo, 1892-3.
Taft, Prof. L. R.—Greenhouse Construction.
United States Reports:
Dept. of Agriculture, Rep't of Sec'y, 1892.
Album of Agr'l Statistics, 1889.
Bureau Animal Industry, 1.
Climatic Features of the two Dakotas.
Interior Dept.:
Bureau of Education, 1.
Geol. Survey, Mineral Resources, 2 v.
Monographs, 7 v.
Interstate Commerce Commission, Report 1892.
R. R. Statistics, 1891, 1892, 2 v.
Labor Commissioner, Reports, 3 v.
Navy Dept., Nautical Almanac, 1897.
Treasury Dept., Wool and Manufactures of Wool, 1894.
War Dept.:
Catalogue Library, 2 v.
Chief of Engineers, Report 1893, 6 v.
Ordnance, Report 1892.
Rebellion Records, 10 v.
Victoria Institute—J'l of Transactions, vol. 26.
Unbound donations.
American Museum Natural Hist.—Report 1888-89, 1893.
Bulletin, vol. 5, 1893.

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Amer. Soc. Mech. Engineers—Papers presented at the World's Engineering Congress, Chicago, 1893.
Arkansas Hort. Soc.—1st Report 1893.
Australian Museum—Report 1892.
Record, vol. 5, 1893.
Boston Public Library—Report of Trustees, 1893.
British Columbia—Agricultural report, 1892.
California Acad. Sci.—Proc., vol. 6, part 2.
Occasional papers, No. 4.
Canada. Geol. Survey—Annual report, vol. 3, pt. 1, 2.
Catalogue Museum, Sec. I.
Catalogue of Canadian rocks.
Ontario Sheepbreeder's Ass'n, and Swinebreeder's Ass'n, Report 1892.
Canadian Institute—Report 1892-93.
Trans., vol. 3, pt. 2; vol. 4, pt. 1.
Carpenter, R. C.—Variation in steam engine.
Clarke, W. B. & Co.—Problem of man flight. Means.
Cressy, N.—Report on veterinary inspection in Conn.
Davis, J. J.—List of parasitic fungi of Wisconsin.
Detroit Board of Trade—Report, 1893.
Draper, D.—N. Y. Meteorological observ. hourly readings, 1893-4.
Edwards, Dr. H.—Value of English training.
Essex Institute—Bulletins.
France—Agriculture. 16.
Frazer, J.—Sunset at Mackinac and other poems.
Hamilton Ass'n—J'l and Proc., 1892-93.
Illinois Museum Nat. Hist.—Bulletin No. 3.
Indiana Academy of Science—Proc., 1892.
Johns Hopkins Univ.—2.
J'l Elisha Mitchell Scientific Soc. F. P. Venable.
Massachusetts—Horticulture, Report 1892, pt. 2; 1893, pt. 1. Rob't Manning.
Michigan Reports:
Agriculture, 1892.
Corrections and Charities, 1892.
Dairy and Food Commissioner, 1893.
Mich. Drain Law.
State Board of Health.
Sup't of the Poor.
Missouri—Horticulture, Report 1892.
New S. Wales—Agricultural Gazette.
N. Dakota—Agriculture, 1893.
Smith, Prof. C. D., 2.
Smithsonian Institution, 7.
Stout, Hon. B. G., 2.
Tennessee—Agriculture, 1891-92.
Board of Health Bulletins.
United States:
Coast and Geol. Survey, 5.
Civil Service Commission, 9th report.
Geol. Survey, 1.
Dep't of the Interior—Census Bulletins.
Education, Bureau of, 3.
Labor Commissioner—6th special report.
Navy Dep't—Report on steam engineering.
Patent Office—Report of Commissioner, 1892.
State Dep't—Bureau Amer. Republics, 6.
Consular Reports, 3.
Treasury department—Quarterly reports. Bureau of statistics.
War department.—Army register.
General atlas, 9 parts.
Virginia.—Agriculture, 1893.
Winchell, N. H. Geol. and Nat. Hist. Survey of Minn. Report 1892.

In the reading room may be found the following publications:

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PURCHASED.

FOREIGN.

Agricultural Gazette.
Annals of Botany.
Annales de Chimie.
Analyst.
Blackwood's Magazine.
Botanische Centralblat.
Canadian Entomologist.
Chemical News.
Edinburgh Review.
Electrician.
Engineering.
Englische Studien.
Entomologist's Mo. Mag.
Entomologist.
Garden.
Gardener's Chronicle.
Gardening World.
Journal of Anatomy.
Chemical Society.
Horticulture.
Royal Agricultural Society.
Royal Microscopical Society.
Lancet,
Magazine of Art.
Mind.
N. British Agriculturist.
Phil. Trans. Royal Society of London.
Proceedings, " " " "
Revue Horticole.
Veterinarian.
Westminster Review.
American.
Agricultural Science.
American Agriculturist.
Cheesemaker.
Cultivator.
Chemical Journal.
Dairyman.
Engineer and R. R. Journal.
Florist.
Gardening.
Journal of Science.
Machinist.
Meteorological Journal.
Microscopical J'l.
Naturalist.
Veterinary Review.
Annals Amer. Academy Political Science.
of Mathematics.
Arena.
Art Amateur.
Atlantic Mo.
Auk, The.
Botanical Gazette.
Breeder's Gazette.
Bulletin Torrey Botanical Club.
Catalogue of U. S. Publications.
Century Mag.
Chicago Tribune, daily.
Cosmopolitan.
Country Gentleman.
Critic.
Detroit Free Press, daily.
Tribune, "
Drainage Journal.
Economics Quarterly.
Education.
Educational Review.
Electrical World.
Engineering Magazine.
Mechanics.
News.
Entomological News.
Farmer's Review.
Fortnightly Review.
Forum.
Garden and Forest.
Gardening.
Harper's Monthly.
Weekly.
Hoard's Dairyman.
Independent.
Industry.
International J'l of Ethics.
Jersey Bulletin.
Journal Ass'n American Engineers.
Comparative Medicine,
Franklin Institute.
Morphology.
Johns Hopkins Univ. Studies.
Circulars.
Judge.
Library J'l.
Literary World.
Living Age.
Meehan's Monthly.
Michigan Fancier.
Farmer.
Microscope.
Modern Language Notes.
Nation.
National Stockman and Farmer.
Nature.
News and Courier.
New York Tribune.
World.
Nineteenth Century.
North American Review.
Ohio Farmer.
Orange Judd Farmer.
Ornithologist.
Outlook.
Pacific Rural Press.
Physical Review.
Political Science Quarterly.
Popular Science Monthly.
Poultry World.
Power.
Prairie Farmer.
Proceedings Academy Natural Sciences.
American Phil. Society.
Entomological Soc. of Wash.

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Psyche.
Public Opinion.
Pub. American Economic Association.
Puck.
Quarterly Review.
Railroad Gazette.
Review of Reviews.
Rural N. Yorker.
Science.
Scientific American.
Supp.
Scribner.
Southern Cultivator.
State Affairs.
Trans. Amer. Entomological Society.
Vick's Monthly Magazine.

Donated, or received in exchange:

Adrian Times.
Albion Recorder.
Allegan Gazette.
American Creamery.
Horsebreeder.
Missionary.
Sentinel.
Sheepbreeder.
Swineherd.
Avalanche, The.
Baltimore Sun.
Battle Creek J'l.
Cadillac News and Express.
California Cultivator.
Charlevoix Democrat.
Christian Register.
Clinton Independent.
Cultivator (Nebraska).
Deaf Mute Mirror.
Detroit F. Press (twice a week).
Evening News (Saginaw).
Farm and Home.
Farm, field, and fireside.
Farm and fireside.
Farm Journal.
Farmer's Advocate.
Home.
Journal.
Fruit Grower's J'l.
Good Health.
Grand Rapids Democrat.
Traverse Herald.
Grange Bulletin.
Visitor.
Hillsdale Leader.
Standard.
Hoard's Dairyman.
Home Companion.
Homestead.
Hospodar.
Industrial American.
Industrialist.
Ingham Co. News.
Ionia Sentinel.
Jackson Patriot.
Jonesville Ind'p't.
J'l of Agriculture.
J'l N. Y. Micros. Society.
Kalamazoo Telegraph.
Lansing Journal (daily).
(weekly).
Literary News.
Locomotive.
Louisiana Planter.
Mail and Times.
Maryland Farmer.
Marine City Magnet.
Midland Republican.
Mirror and Farmer.
Moderator.
Monthly Weather Review.
Official Gazette.
Orange Judd Farmer.
Practical Farmer.
and Fruitgrower.
Roscommon Democrat.
Saginaw Courier-Herald (daily).
Sault Ste. Marie News.
Social Economist.
Soo Democrat.
State Democrat.
Republican (daily).
Skördemannen.
Toledo News.
Three Rivers Tribune.
Traveller's Record.
Traverse Bay Eagle.
Western Agriculturist.
Plowman.
Swineherd.
Wolverine Citizen.
World, N. Y.

The library is open to students thirteen hours each week day, and seven hours on Sunday. 4,076 books have been loaned during the year, no record being made of books used in the library, or of those in the department offices.

The gallery on the north side of the library was built during the winter, and as the shelves are already nearly filled with books, more room will be required in the near future.

A change for the better has been made in the system of lighting the library, for which we are indebted to Prof. Woodworth. Improvements

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have been made in the librarian's office, and I am sure the effort to promote the comfort and convenience of those using the library, is appreciated by all.

Respectfully submitted,
LINDA E. LANDON,
Librarian.

AGRICULTURAL COLLEGE, MICH., *June 30, 1894.*

REPORT OF THE FARM HOME READING CIRCLE.

To the President:

SIR—The interest manifested in the work of the Farm Home Reading Circle during the year just closed has been very gratifying. The circle has made a steady growth and a large number of farmers and others not directly interested in agriculture have availed themselves of this opportunity to increase their knowledge of agricultural subjects.

During the year 5,000 short circulars and 2,000 large circulars, containing detailed information of the plan and scope of the course, have been printed. There have been distributed nearly 500 books through this plan, on subjects pertaining to general agriculture or to special lines of farming.

The actual number of members registered is 125; but this in no sense represents the number who are actual students of the course. Many granges, farmers' clubs, etc., have purchased books to be read as a part of their program. Library associations have, in some cases, secured books through the College, and the number who come directly under the influence of the course through these various agencies can be estimated with difficulty. It is of great importance that the plan and scope of the work be kept constantly before the people and its practical workings explained in detail. Wherever the course has been thoroughly tried, and its opportunities appreciated, it has met with success.

The value of this course to farmers actually engaged in the business of farming cannot be overestimated. Its commendable object is to bring the farmers and College into more intimate and friendly relations, which can but result in advantage to both.

Respectfully submitted,
F. B. MUMFORD,
Secretary.

AGRICULTURAL COLLEGE, MICH., *June 30, 1894.*

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REPORT OF THE DEPARTMENT OF PHYSICS.

To the President:

SIR—I have the honor to present herein a report of the department of physics for the year ending June 30, 1894. The work in this department also includes an elective short course in electrical engineering. The instruction in physics is now arranged so that all required class work is given the second, third and fourth terms of both courses. The work pursued remains as outlined in my last report. In addition to the required work there have been given three terms of elective work, as follows: A course of lectures and experimental work on advanced physics for agricultural seniors. The laboratory work consisted of one hundred hours' laboratory practice. A course of study for mechanical seniors in electrical engineering including fifty hours' laboratory work. The third course consisted in a series of demonstrations and laboratory work for summer normals. Throughout the year there have been from two to five special or post graduate students whose work required special supervision. All the work in this department has been carried by myself. The following table shows the amount of work done at College and the part taken by this department. The table is for regular students in academic work and excludes specials, post graduates, ladies, manual labor and shop practice:

Regular students.	In college course.			In physical department.		
Class.	No.	Average hours per week.	Student hours.	No.	Average hours per week.	Student hours.
Agricultural freshmen	53	18½	971½	53	2⅝	141½
Mechanical freshmen	45	18⅔	840	45	3⅓	150
Agricultural sophomores	39	19⅔	767	39	1⅓	52
Mechanical sophomores	37	21	777	37	1⅔	61⅔
Agricultural juniors	29	19⅔	570½	29		
Mechanical juniors	18	19¼	324	18		
Agricultural seniors	19	20	380	16	1⅔	26⅔
Mechanical seniors	12	18⅔	224	12	2⅓	28
Total			4,854			459½
Average number students per day			97.08			91.8
Percentage of total by physical department						9 4-10%

A small amount has been used for the purchase of books. The question of books is a very important one in technical branches. It is very hard to obtain text books for students which keep up with the rapid progress in physical and electrical work. One object of the lecture system is that of constant revision to keep up to date. There are, however, serious objections to the method when used without copious references. The clearer the lecturer presents his subject the easier it is for the student and the result is that less thought is put upon the subject than if it were presented in a more complex style. If when each specialty is under discussion the student has access to good books, the work can be arranged so as to require

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both an exercise of the reasoning powers and the ability to charge his memory rather than his note book. I recommend that in the future a large percentage of the available funds be used for the purchase of books rather than for apparatus.

The apparatus now in the laboratory enables excellent work to be done by a very limited number of students. More room for laboratory work is now one of the pressing demands of the department. The advancement of the work makes it essential that more apparatus be secured. Very great advancement has recently been made in practical instruments.

The simplicity of modern methods in photography has brought about its general use by all engineers whether agricultural, mechanical, civil, mining, or electrical. The photometric room has been arranged during the past year so that ten students can work at photographic manipulations at the same time without interference. Students in both courses have used the room extensively.

The installation by this department of the College Electric Light and Power Plant has been and will continue to be of educational value to all students. The dynamo was presented by Mr. E. F. Cooley, of Lansing, and is being operated at five hundred volts, sixteen amperes. The overhead main line wires were put up with the expectation that sometime in the future we will have a complete high tension system. There are numerous demands from advanced students and post graduates that this College furnish a good training in the fundamental theory and practice of electrical engineering. I believe that with the coöperation of the mechanical department the desired result could easily be obtained by an extension of the course already inaugurated. Such a course could be made elective to mechanical seniors only and run through the senior year. The course will furnish strong inducements to advanced students and supply the requisite foundation for entering upon this special line of work.

There has been an interest shown by students in the department and an apparent desire to do good work which has been quite gratifying. In conclusion I wish to acknowledge my appreciation of the support you have given for developing this department.

Very respectfully,

PHILIP B. WOODWORTH,

Assistant Professor of Physics.

AGRICULTURAL COLLEGE, MICH.,
June 30, 1894.

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REPORT OF THE STEAM AND WATER DEPARTMENT.

To the President:

SIR—The following are the more important alterations, repairs, and additions made in this department since September 1, 1893:

The river cistern has been connected with the river by a 12-inch sewer pipe laid in cement.

New plungers and rings have been placed in the Worthington fire pump.

A foundation for an 8 x 12 engine has been constructed at the boiler house and the engine placed on same. This engine is the one formerly used to drive the shops, and is now employed to drive a dynamo used in lighting the grounds.

An exhaust head, of sufficient capacity for exhaust of pumps, and 8 x 12 engine, has been placed in position at the boiler house.

A hydrant has been placed at the hennery, and two of the old hydrants have been replaced with new.

A three-quarter-inch water pipe has been laid to Mr. Davis's residence, and a one-inch water pipe to the hospital.

A few new tools have been purchased for the department, such as stock and a set of dies, pipe-vise, plumber's force pump, etc.

The services of an additional fireman have been secured, thus ensuring better adjustment of the steam heating and more protection against fire, as we now have a fireman on duty during the entire night.

Last fall term heating was carried on as usual. During the winter vacation the library building and the mechanical building were heated by steam from the main plant; steam was also furnished during the same period for the engine used to drive the shops. The Abbot Hall heating system was in operation during the winter vacation.

In addition, I would call attention to the fact that much of the steam plant has experienced service of such duration as to necessitate continual repairing; also that the present arrangement of the plant is not such that a high efficiency can be obtained under existing demands. We would recommend that practically two plants be established in the near future, one for heating purposes and the other for driving engines, pumps, etc.; also that numerous changes be made in the system of piping for steam heating.

Such changes as just noted would lead eventually to a saving of money, and it would seem advisable that such changes be taken under consideration.

We would particularly recommend the immediate consideration of plans for the erection of a new coal shed, for new floors in boiler and pump rooms, and for a new smoke flue at the boiler house.

Respectfully submitted,

CHAS. L. WEIL,
Superintendent.

AGRICULTURAL COLLEGE,
June 30, 1894.

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SEVENTH ANNUAL REPORT

OF THE

AGRICULTURAL

EXPERIMENT STATION

OF THE

STATE AGRICULTURAL COLLEGE OF MICHIGAN

FOR THE

YEAR ENDING JUNE 30, 1894.

[For members and organization of the State Board of Agriculture in charge of the station and the list of officers, see pp. 4 and 5 of this volume.]

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EXPERIMENT STATION.

The following account shows the receipts and expenditures of the experiment station for the year:

The full amount allowed by law has been expended for building purposes, viz., $500 for a poultry house and yards and $250 for fitting a dairy room. The receipts from license fees on commercial fertilizers is larger than heretofore showing an increasing sale of this article in the State.

The list of persons to whom the station bulletins are sent has nearly doubled during the year, and special requests for the fruit bulletins and spraying circular have been in great numbers. The station is now in a position to send out valuable information and results of experiments each year, and farmers and fruit growers are learning more and more to seek aid from the experiment station in practical agriculture and horticulture, the destruction of insect pests, and fungus diseases of grain and plants.

A poultry department has been added to the station during the year and work in this line will be a part of the station work in the future.

I. H. BUTTERFIELD,
Secretary.

REPORT OF THE SECRETARY AND TREASURER FOR THE YEAR ENDING JUNE 30, 1894.

July 1, 1893—By balance overdrawn			$495 25
July 10, 1893—To U. S. treasury on account of, 1st quarter	$3,750 00		
Oct. 7, 1893—" " " " " " 2d "	3,750 00		
Jan. 10, 1894—" " " " " " 3d "	3,750 00		
April 9, 1894—" " " " " " 4th "	3,750 00		
June 30, 1894—" license fees on 58 commercial fertilizers	1,160 00		
" " —" miscellaneous receipts as per accounts filed in the office of the State Auditor General	684 57		
" " —By disbursements as per vouchers filed in the office of the State Auditor General			14,646 82
" " —By balance on hand			1,702 50
	$16,844 57		$16,844 57

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SUMMARY OF DISBURSEMENT ACCOUNT.

Buildings—		
To repairs to apartment house	$70 07	
poultry house, partially completed	421 54	
dairy room	250 00	
		$741 61
Salaries—		
To director	$500 00	
secretary and treasurer	500 00	
librarian	120 00	
three heads of departments	1,500 00	
eleven assistants	4,763 66	
		7,383 66
Farm Department—		
To labor	$492 23	
sheep and lambs, $247.25; feed, $232.27; scales, $24.00	503 52	
camera and photograph material, $92.24; typewriter, $97.50	189 74	
team, $150.00; harness, $25.00; seeds, $41.68; tile, $3.13	219 81	
thermometers, $30.83; fertilizer, $5.87; boxes, $10.25	46 95	
dairy apparatus, $24.38; three silage tanks, $94.47	118 85	
sundry apparatus, $14.82; stationery, postage, and freight, $73.79	88 61	
		1,659 71
Horticultural Department—		
To labor	$41 84	
typewriter, $105.00; binding books, $47.00	152 00	
spray pump, hose, etc., $32.04; travel, $16.35	48 39	
feed for team, $46.48; seeds and plants, $133.40	179 88	
stationery, postage and freight	48 48	
fertilizer, $5.50; chemicals and drugs, $25.20	30 70	
photograph material, $19.83; sundry, $25.01	44 84	
		545 77
Chemical Department—		
To procuring samples commercial fertilizers	$75 00	
apparatus and chemicals	191 01	
travel, $21.47; stationery, postage and freight, $20.70	41 67	
		307 68
Botanical Department—		
To labor	$2 00	
postage and freight, $3.50; travel, $8.20	11 70	
		13 70
Zoölogical Department—		
To travel, $31.10; jars, $24.25; cases, $10.80	$66 15	
postage, stationery and freight, $25.85; sundry, $30.40	56 25	
		122 40
Library—		
To books		604 72
Veterinary Department—		
To apparatus, $1.75; material for World's Fair Ex., $26.00	$27 75	
travel and attendance at World's Fair	37 85	
		65 60
Grayling Sub-station—		
To labor	$359 89	
seeds, $11.40; fertilizer, $4.22; travel, $54.85	70 47	
		430 36

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South Haven Sub-station—		
To labor	$1,649 38	
travel, $45.61; fertilizer, $71.75; seeds and plants, $68.69	186 05	
rent and taxes, $131.06; tile, $21.25; sundry, $4.85	157 16	
spraying chemicals	14 71	
		$2,007 30
Apiary—		
To salary of superintendent	$500 00	
sundry	7 75	
		507 75
Poultry Department—		
Eggs, $19.49; freight, etc., $8.59		28 08
Offices—		
To traveling and convention expenses	$34 90	
cuts for bulletins, $32.46; mailing list, $84.59	117 05	
freight, $31.33; stationery, $8.55; sundry, $36.65	76 53	
		228 48
		$14,646 82

This expenditure may be more briefly summarized and classified as follows:

Salaries of officers at central station	$7,383 66	
Wages	3,044 98	
Buildings	741 61	
Other property	1,810 61	
Seeds and plants	255 17	
Traveling expenses	325 33	
Feed and fertilizer	366 09	
Miscellaneous	719 37	
		$14,646 82
To repay current account for amount overdrawn		495 25
Total expenditures		$15,142 07

I. H. BUTTERFIELD,
Secretary and Treasurer.

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REPORT OF THE DIRECTOR.

To the Honorable State Board of Agriculture:

GENTLEMEN—I submit herewith my annual report as director of the experiment station for the year ending June 30, 1894.

For a detailed statement of the work done during the year, I refer you to the reports of the other officers of the station which are submitted herewith, and to the bulletins which are published as a part of this annual report. The work of the station has been along the same general lines as heretofore, with the exception of the experimental work in the dairy department, and more attention to field experiments. We deem it advisable to exercise great caution with the experiments, and to consider carefully all the various elements that may enter into the results, thus to avoid any erroneous conclusions. For this reason we are not ready at the present time to announce the results of many experiments that are in progress. The usefulness of the bulletins to the farmers of the State is becoming more and more apparent from the increased demand for them. Cognizant of the permanent value of many of the bulletins, we have had them printed on better paper, and in many cases several bulletins have been combined and bound in pamphlet form.

During the year we have issued the following bulletins:

Bulletin No. 101. Composition of Wheat and Straw. Composition of Certain Forage Plants. Adulteration of ground feed. Mineral Residues in Sprayed Fruits.

Bulletin No. 102.—Insects Injurious to Celery.
" 103.—Peach and Plum Culture in Michigan.
" 104.—A Year Among Fruits. (Report of South Haven Sub-station).
" 105.—Michigan Fruit List.
" 106.—Strawberries and Raspberries.
" 107.—Fattening Lambs.
" 108.—Potatoes and Potato Scab.
" 109.—Variety Tests of Vegetables.
" 110.—The External Conformation of the Horse.

These bulletins are sent to anyone who requests them. Our mailing list now numbers over 11,000. Besides this, every paper in the State receives a copy, and the press has been very liberal in its reviews of the bulletins.

The call for some of the bulletins was so great that we were obliged to issue extra editions. Besides the bulletins mentioned, we issued in March a calendar bulletin on the Prevention of the Potato Scab, and in April a poster bulletin on Spraying Fruit Trees. The demand for the latter was so great that we issued a special bulletin on the same subject.

The only building erected for the experiment station was a poultry house.

The changes in the station staff during the year were as follows:

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Prof. P. M. Harwood, agriculturist, resigned, and Prof. Clinton D. Smith took his place; Mr. A. A. Crozier was appointed assistant in agriculture; Mr. H. S. Dunning was appointed assistant in poultry experiments; Mr. R. J. Coryell, assistant in horticulture, resigned, and Mr. U. P. Hedrick was chosen for the same position; and Mr. L. A. Clinton, assistant to director, resigned, and Mr. H. M. Howe was chosen in his place.

A complete list of the station officers may be found at the beginning of this report. Besides the work accomplished by the regular station officers, much careful and valuable experimental work has been done by the students of the College.

The sub-station at South Haven is still under the capable management of Mr. T. T. Lyon, and the work at the sub-station at Grayling has been discontinued for the present.

Respectfully yours,

LEWIS G. GORTON,
Director.

AGRICULTURAL COLLEGE, MICH.,
June 30, 1894.

REPORT OF AGRICULTURIST.

To the Director:

SIR—The experiments performed in this division of the experiment station during the year ending June 30, 1894, naturally group themselves under three heads, field crops, stock feeding and the dairy.

FIELD CROPS.

Mr. A. A. Crozier, formerly of the Department of Agriculture at Washington, D. C., and later botanist of the Iowa experiment station, was appointed assistant agriculturist on the 15th of March, 1894, and was placed in immediate charge of the field experiments.

The soil of the College farm is of very uneven character, poorly adapted to experiments for the determination of comparative yields. The land alternates between clay, sand and low areas of muck which were originally swamps. To lessen the liability to error from the irregularity of the soil, the size and number of the plots have been increased and a series of seventy-two tenth acre plots is being planted to the same crops for a term of years for the sole purpose of determining their natural variation in yield when subjected to the same conditions. The results of this cropping will be used as a basis for judging future experiments conducted upon these plots.

The students in the College assist in the routine and experimental work of the station. This labor is not only valuable to the station but is also of much educational benefit to the students themselves. The agricultural students of the sophomore class and such seniors as elect, are assigned for

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an entire season to the farm department and to members of these classes experimental work is assigned.

The following experiments are being conducted by students the present season: Different methods of killing Canada thistles; different methods of killing quack grass; salt as a fertilizer; a series of fertilizers for wheat; continuation of a former experiment on the improvement of corn by selection and improved culture; cross fertilization of corn; effects of the removal of tassels from a part of the stalks of corn; testing the comparative results from planting large and small seed; effect of frequent cutting on the total yield of hay per acre; different methods of preventing stinking smut in wheat; different methods of preventing smut of oats; testing proposed remedies for corn smut; testing the efficacy and economy of the use of bisulphide of carbon in the extermination of woodchucks; experiment in pig feeding to test the relative value of ground and unground wheat; experiments in the growing of roots. Two students have charge of a miscellaneous collection of the least known forage and other economic plants.

The study of forage plants is receiving increased attention the present season. The severe drouths of the past few years have caused considerable inquiry for grasses adapted to summer pasture, while the recent failures of clover, particularly as a seed crop, in this State, have led us to search for a possible substitute for this valuable forage plant. Thirty-five acres were sown in the spring of 1894 to various grasses and their mixtures. A series of half acre plots previously seeded has been maintained.

A field of *Lathyrus silvestris*, planted in 1891, from seed imported from Europe, has been enlarged and watched with interest during the season. The severe drouth of midsummer prevented the formation of seed except a small amount on the second crop. The yield of hay was three tons per acre with a vigorous second growth suitable for pasture. The value of this plant for the latter purpose, however, is still somewhat in doubt owing to the evident preference of stock for the ordinary grasses. Sheep taken from mixed pasture and closely confined upon the *Lathyrus* lost in weight. Three cows brought in from fresh timothy and blue grass pasture ate the *Lathyrus* at first with considerable reluctance but after a time consumed nearly as much of it daily and gave rather larger yield of milk than a similar number of cows fed upon green timothy. The promising characters of this forage plant as a partial substitute for clover in certain localities appears to fully warrant its continued trial, and arrangements are being made to have it tested in the northern part of the State, where it is hoped the climate will prove more reliable for the production of seed.

As a special catch crop to be sown when clover or the ordinary grasses fail, millet has received particular attention at the hands of the station this season. All the obtainable varieties have been grown and about twelve acres of land devoted to this crop. The results will appear later, in a comprehensive bulletin upon this subject.

The question of weeds has forced itself upon our attention, particularly that of the Canada thistle. The College farm is traversed by two lines of railroad, by which this and other weeds are introduced. As a result the Canada thistle has appeared in all of our cultivated fields. Vigorous measures are being taken to exterminate it, which bid fair to be entirely successful. A record is kept of the methods employed which will doubtless prove valuable to others similarly situated.

The experiments with wheat to aid in determining the best methods of

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combating stinking smut are continued. Fifty-six different treatments of the seeds were made, some chemical, others merely mechanical.

The results as far as determined point to soaking the infected seed for 24 hours in a supersaturated solution of lime as the most efficient and economical method of treatment yet tested. The Jenson hot water treatment at temperatures varying from 130 to 140 degrees Fah. was thoroughly tried but was not as efficacious as the lime water. The crop from seed treated with hot water had a large number of smutted heads while the other part of the same sample of seed treated with lime water yielded a crop containing no smut whatever.

Study was expended on this subject and a press bulletin giving the results will be issued in time to give the farmers an opportunity to apply the method to infected seed wheat this fall.

A similar experiment was tried with oats to discover some effective method of lessening loose smut. The Jenson hot water method proved excellent for this purpose.

DAIRY.

The purchase of apparatus for the special dairy course and for the regular dairy instruction in the College, made it possible to undertake experiments in the handling of milk and cream and the manufacture of butter.

The crying need of practical experiments in this department of our work is manifest when the backward condition of the dairy interests of Michigan is contrasted with the intense activity and rapid advancement along dairy lines in other states.

Beginning, therefore, with the milk as it is drawn from the cow, we have conducted practical experiments covering a large part of its history until the finished product, the packed butter, is turned out. The results of these experiments will be published later in a bulletin and it is unnecessary in this report to undertake even to give a list of them.

By the use of the test, a complete record of the yield of both milk and butter-fat for each cow in the herd is made possible. By charts a complete history of every operation performed in the dairy is preserved for future use.

Especial attention has been given to the ripening of cream and details of the operation of churning, noting the effects of variations in temperature and acidity on the per cent of fat in the buttermilk. Questions relating to the washing of butter have received considerable study and valuable results have been obtained.

A study of the records of our cows has given valuable data bearing on the treatment of cows to secure the largest yields at least cost. A test of creamers has shown important differences in efficiency and has demonstrated the practical impossibility of removing all the butter-fat from the milk with cold deep setting in the latter part of the period of lactation. Separators were tested and much information has been gained in regard to their proper place in our economy.

STOCK FEEDING.

Fifteen acres of rape were grown in the fall of 1893, and experiments conducted to determine its value for forage for lambs. The rape was sown

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over part of the field in drills, the rest broadcast. Where the land is at all weedy it appeared manifestly much better to sow the seed in drills to allow a free use of the cultivator while the plants are small. Where the land is clean the rape will do nearly if not quite as well when sown broadcast as when sown in drills; more seed is of course required in the latter case.

The rape grew well and furnished an abundant and very satisfactory fall feed. One acre furnished the entire feed of nine lambs for seven weeks. In that time they gained 22.5 pounds each, or at the rate of 200 pounds of gain per acre of rape. The lambs were worth when taken from the rape, five cents per pound. The acre of rape was worth therefore ten dollars. As the rape is not sown until the middle or latter part of June, ten dollars per acre is a fair compensation for the use of the land and the labor involved.

A large number of farmers in Michigan are engaged in the business of fattening lambs for the eastern markets. The importance of this industry is so great that the station has undertaken a series of experiments for the purpose of investigating the value of the best foods and methods of feeding for the economical production of mutton. The leading grains and bye-pro lucts employed were corn, wheat, bran, and oilmeal. The value of roots in a ration was also tested. A great many feeders have successfully employed a self feed for fattening lambs and several lots were fed to test the economy of this method of feeding.

Incidently some observations were made on the influence of temperature on the gains made and the amount of dry matter required to produce a pound of gain. The results confirm those of former experiments in showing that in general corn is the most valuable constituent of the grain ration for fattening lambs. Wheat fed to lambs yielded a considerably greater profit than could have been obtained by selling the grain in the open market.

Lambs fed roots made the largest gains and with the least consumption of dry matter per pound of gain.

Fattening lambs with a self feed proved to be expensive. Cold temperatures were quite generally favorable to large and economical gains.

A trial was made of ensilage for breeding ewes with good results. It was shown that corn, thus preserved, formed the basis of a cheap and efficient ration for this class of farm animals.

With pigs experiments were conducted to test the value of wheat alone and a mixture of wheat and corn for growing pigs. The gains made by the wheat fed pigs were very large and gave a high price for the wheat consumed. Tests were also made of the value of skimmilk and buttermilk during the progress of the dairy school. The results of these experiments will appear in the bulletins later.

Several experiments in the feeding and care of dairy cows were conducted during the winter. The place of wheat in the grain ration received attention. The effects of various feeds on the quality and hardness of the butter were studied and important results obtained.

The work at the substation at Grayling was suspended at the close of the season of 1893.

Respectfully submitted,

CLINTON D. SMITH,
Agriculturist.

AGRICULTURAL COLLEGE, MICH.,
June 30, 1894.

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REPORT OF THE HORTICULTURIST.

To the Director:

SIR—From the fact that in previous years the annual reports of this department have been presented in December and have covered the entire growing season, the period to be accounted for in this report dates only from January 1 and can only outline the work that is now in progress, as results have been secured from very few of them.

BULLETINS.

During the winter the time of my assistants and myself was occupied in the preparation of a number of bulletins, in which the results of such experiments as were ready for publication were compiled.

They were named and numbered as follows: No. 103, Peach and Plum Culture in Michigan; No. 104, A Year Among Fruits (South Haven Substation Report); No. 105, Michigan Fruit List; No. 106, Strawberries and Raspberries; No. 108, Potatoes and the Potato Scab; No. 109, Variety Tests of Vegetables.

Nos. 103–6 were issued under one cover as fruit bulletins, while the others were bound in the same volume with other bulletins from the farm and veterinary departments.

In order to present the results of our experiments upon potato scab before the farmers in a form that would be convenient for reference and preservation, Poster Bulletin No. 1 was prepared and distributed. It was sent to each of the postoffices and to all of the grange and farmers' club halls, with the request that it be posted in a conspicuous place; a copy was also sent to each of the crop correspondents and so long as the supply lasted they were sent to all farmers who requested a copy.

As we were in receipt of large numbers of requests for information as to the best remedies against the various insects and diseases of fruits and vegetables, a companion poster bulletin upon this subject was prepared and distributed with No. 1. It formed a complete spraying calendar, showing the remedies that would be found most efficacious against the various pests, the method of preparing them, and the time for applying them. As the call was large, the edition was soon exhausted and it was reprinted in pamphlet form, together with descriptions and illustrations of the peach "yellows" and black knot of the plum, which are becoming quite destructive in sections where their nature is not understood and the proper remedies used. As we had received many calls from yellows commissioners in various parts of the State for literature upon the subject, a copy of the Michigan yellows law was included and an endeavor was made to secure for them a wide circulation in sections where these diseases prevail.

SUB-IRRIGATION IN THE FORCING HOUSES.

The forcing houses were made use of in the winter in experiments to determine the effect of sub-irrigation upon plants grown under glass.

Carnations were grown in one house and lettuce in the other, upon the

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side benches. The benches were first made practically tight by closing up the cracks that had been left the previous year between the bottom boards. They were placed close together and firmly nailed, the closing of any cracks that might remain being left to the swelling of the boards. The interior of the beds then received a thick painting with water lime, thinned with water and applied with a brush.

The beds prepared in this way proved practically water-tight and the only additional expense over the usual form of bench was for the extra amount of boards required to fill the space usually occupied by the cracks. The cost of the cement is not considered as its preservative effect upon the bench bottoms makes it a desirable coating for any bench.

Two benches about forty feet in length by three and one-half in width were used for each of the above crops; in one the sub-irrigation was provided by means of three-inch drain tiles and in the other one-inch gas pipes pierced at intervals of one foot with one-fourth inch holes were used. The tiles and pipes were placed upon the bottoms of the beds, one row of tiles and two of pipes being placed lengthwise of each bed. An elbow and and short nipple at one end of each pipe and a similar opening to the tile allowed the water to be supplied either with a hose or watering can. The beds were then filled with about four inches of rich compost. Two crops of lettuce and one of carnations were grown while the systems were in use.

From the first, the advantages of this method of applying the water were noticed, particularly with the lettuce. Among the benefits were the saving in time of watering as the portions to which the water was applied upon the surface required watering fully twice as often as those where it was distributed beneath the soil. Moreover, the amount of water used was even more in excess. The application of this large amount of cold water to the surface of the soil in the depth of winter, and its subsequent evaporation, could hardly have other than an injurious effect upon the growth of the plants, and this was shown to be so by the results obtained. The crop of lettuce upon the sub-irrigated portion matured fully ten days earlier than that on the portion which was surface watered. As three crops are grown under ordinary conditions, the combined gain would be sufficient to be of considerable value in the forwarding of other crops.

Much of the danger of loss in the growing of lettuce comes from the fact that the grower is caught at the beginning of a period of dull weather with his beds surcharged with water, or it may be that the appearance of the rot is induced by insufficient ventilation combined with an excess of water in the surface soil or upon the foliage, while with sub-irrigation there is no danger from this and the house can be carried several degrees higher than the normal for lettuce without danger. It can be seen from the above that as less care is required in the watering it can be entrusted with safety to less experienced men than are needed ordinarily.

With a little practice the amount of water required was soon learned and both systems worked equally well, except that we were obliged to occasionally clean out the holes in the iron pipe. As the drain tile is cheaper and in various ways more satisfactory we believe it to be preferable. For a bed less than four feet wide one row of tile will be sufficient and, from our experience with it in the open ground, it will work well to a length of fifty feet if properly laid. It should be placed as level as possible, although a slight slope is not objectionable. A small crack may be left between the tiles but in placing them care should be taken that the spaces are even in size.

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We found the same advantages with the use of this system for carnations, except that there was no gain in the time of flowering. It was noticeable, however, that when warm weather came, they held out much better, and the flowers were of a larger size.

SUB-IRRIGATION FOR CELERY.

In many of the celery districts of the State, water is found throughout the summer within two feet of the surface, but in others the water, without which no success can be obtained, falls to a considerable depth. Surface irrigation has been tried, but it has serious faults, and our success with sub-irrigation in the greenhouse prompted us to try it for this crop. Our only ground that is in any way fitted for celery is a piece of drained muck swamp, and here we have placed tile drains at the depth of one foot, between alternate rows of celery, and have arranged it so that water can be supplied at one end of the line with a hose. The system works perfectly so far as supplying the water is concerned, but it is too soon to judge of its effects upon the growth of the plants.

SPRAYING AGAINST INSECTS AND DISEASES.

A thorough trial has been made of the remedies that have been recommended from time to time in our bulletins, and the results confirm our previous opinion of them and of the desirability of spraying all fruit crops.

The canker worms were quite numerous in the large apple orchard, but they were readily destroyed with Paris green used in combination with Bordeaux mixture for the scab. The Paris green also served for the destruction of the codling moth and tent caterpillar.

Although the cold rains that followed the blossoming period were particularly favorable for the development of the apple scab fungus upon both fruit and foliage, our sprayed trees were but little troubled, while those unsprayed lost many of their leaves and those that remained upon the trees are in an unhealthy condition. The fruit also dropped badly, in some cases nearly all of the apples fell from the trees, while those that remained are scabby, undersized and misshapen.

While the season was unusually favorable for the development of the fungus, and even more so for the application of fungicides and insecticides, the sprayed trees present a comparatively healthy condition, as the leaves are but slightly injured by the fungus and very few of either leaves or fruit have dropped.

The results of the applications to the peaches for the curl leaf were more successful than in 1893. Owing to continued rains at the time when the spraying should have been done, the curl had quite a start upon some of the trees before the application was made. The Bordeaux, however, quickly checked it and the sprayed trees have been up to the present time quite free from disease. In one or two cases it showed itself, but they were trees that suffered badly last year and it is probable that the mycelium of the fungus wintered over in the twigs and was able to spread to the new growth without coming to the surface where the fungicide could act upon it.

The results from the treatment of the strawberries for the leaf blight

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were equally good, as varieties which in previous years have been seriously injured were almost entirely free from disease.

FERTILIZER TESTS.

The principal attention in this line has been paid to the use of fertilizers of different kinds upon potatoes and tomatoes.

Upon potatoes they were applied to eighteen plots so arranged as to bring out the following points: First, the comparative effects of muriate of potash as compared with sulphate, upon the yield and the quality of the crop; second, to learn if the increased yield from the use of commercial fertilizers is sufficient to warrant their use. For purposes of comparison some of the plots were fertilized with stable manure, ashes and various brands of special potato fertilizers, as well as with several combinations of agricultural chemicals intended to show the special requirements of the soil.

The series of fertilizer plots in use for the past four years has been continued without change, and a trial has been made upon a clover sod to see what gain would be produced by stable manure as compared with a commercial fertilizer.

Upon tomatoes the arrangement of the plots was much the same as upon the potatoes, with the substitution of a special vegetable fertilizer for the potato fertilizers.

As a check upon our results and to distribute the work so that farmers in other sections of the State could see the results obtained, arrangements were made with Mr. L. J. Post of Lowell and R. M. Sprague of Wayland to undertake a similar experiment. In each case the arrangement of the plots was about the same as at the College and the plots measured one-fourth acre each.

Mr. Wm. Voorheis of South Frankfort and Mr. T. S. Braman of Sammons Landing have undertaken some experiments with fertilizers in their peach and plum orchards.

VEGETABLE TESTS.

As in previous years, considerable attention is being paid to the testing of the vegetable novelties, and to various methods of growing the crops. Our largest collections are of potatoes and tomatoes, of which we have some one hundred and fifty varieties each.

A number of remedies are being tried for the prevention of the potato scab, and the experiment is so planned that it should show not only the relative efficiency of the remedy, but the strength that should be used and the proper time for the treatment. They are also being tried upon several varieties and upon both a heavy and a light soil.

THE ORCHARD AND FRUIT GARDENS.

The orchards are all of them promising a moderate crop of fruit. Many of the new sorts of peaches, plums and cherries are coming into bearing and several of the new apples and pears show scattering fruits.

With the exception of a small part of the old apple orchard which is left in sod for comparison, the orchards are all kept in cultivation, with some hoed crop between the rows where the size of the trees permits.

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THE DISTRIBUTION OF TREES AND PLANTS.

In 1889 we commenced the distribution of such of our surplus trees and plants as seemed worthy of trial. Last spring we had on hand several thousand trees, that had been grown by the students, embracing some thirty kinds of peaches, one hundred kinds of apples, and numerous sorts of plums, cherries and grapes besides small fruits of many kinds.

These were sent to some of the leading fruit growers, care being taken to secure an even distribution, while others were sent to the homes of the students and to the alumni of the College.

SOUTH HAVEN AND GRAYLING STATIONS.

The importance of the work being carried on at the substation at South Haven is beginning to be understood by the fruitgrowers along the "lake shore," and many calls have been received for the reports of the yearly operations as presented by the superintendent, Hon. T. T. Lyon. Many of the trees set in 1888 by Mr. Lyon are now in bearing, and the plums, cherries and peaches set in 1890 on the station land are carrying their first crops this year. The frosts and cold rains of the early spring greatly lessened the prospects for a crop.

The collection contains not only the leading commercial varieties, but we have endeavored to secure for trial all of the promising new sorts.

The collection at Grayling includes about fifty sorts of apples and a few each of pears, plums and cherries all of which were selected on account of their supposed ability to withstand the trying climatic conditions that they have to contend against. Although the summers of 1892 and 1893 were quite unfavorable for their development, they made a fair growth and seem to have withstood the sun of summer and the cold of winter without injury.

ASSISTANTS.

To aid in the carrying out of the work of the year I have been aided by the same assistants as for the two preceding years, Messrs. H. P. Gladden and R. J. Coryell, who have shared in the work and in preparing the results for publication in bulletin form.

About the middle of June, Mr. Coryell resigned to take charge of the extensive orchards and grounds at Peach Island, Detroit river. To succeed him Mr. U. P. Hedrick, a graduate of the class of 1893, who had been at work for the past year as an assistant in the department, at the greenhouse, was selected, and he entered at once upon his duties.

L. R. TAFT,
Horticulturist.

AGRICULTURAL COLLEGE, MICH.,
June 30, 1894.

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REPORT OF THE CONSULTING BOTANIST.

To the Director:

SIR—Several farmers and seed dealers have availed themselves, during the year past, of the offer of the station botanist to examine and report on the purity of seeds of grasses and forage plants.

The rapid increase of new weeds in the State, resulting largely from the purchase of seeds grown outside of the State, make such examinations a necessity.

A larger number of weeds have been sent for names than ever before.

Several collections of plants have been sent for names, by former students of the College, from California, Arizona, Idaho, Wyoming, Colorado, and Michigan. These have been added to the College herbarium, and make a valuable addition thereto.

The study of those plant diseases which are caused by the presence of minute fungi, has been continued and full collections made for the College herbarium and for exchanges.

From letters and specimens received during the year, it is evident that the disease known as black knot, affecting seriously our plums and cherries, is steadily marching northward. It has now invaded the orchards about Alpena.

The frequency of this disease on our wild cherries everywhere in the State would seem to make it almost a hopeless task to keep it from our orchards.

The celery leaf-blight has been examined, to learn, if possible, its extent and the amount of loss caused by its presence among the growers of this esculent. Specimens of the diseased plants have been received from Kalamazoo, Jackson, Tecumseh, and Newberry. It is hoped that the work may be continued during the coming year.

Another fungous disease, known as scab, destroyed the entire crop of apricots in the College orchard, while peaches were only slightly affected by it. A fungous disease affecting the peach, *Helminthosporium Carpophielum Lev*, was first observed in this part of the State. Fortunately it caused little or no damage.

The examination of parasitic fungi that prey upon weeds and sometimes destroy them, has been continued during the season. Collections of all weeds thus affected have been made.

Much time in May and June was given to the examination of a fungous disease which first appeared this season, in southern Michigan, as an epidemic, destroying the young of the clover leaf weevil in great numbers, thereby saving from complete destruction the few remaining clover fields. A bulletin, soon to be published by the station, will give a detailed account of this epidemic.

During the winter farmers' institutes were attended at Yale and at Standish.

Respectfully submitted,

C. F. WHEELER,
Consulting Botanist.

AGRICULTURAL COLLEGE, MICH., *June 30, 1894.*

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REPORT OF THE CONSULTING ENTOMOLOGIST.

To the Director:

SIR—The present season has been an exceptional one in the number and severity of insect attacks in our State. The season was earlier than usual and quite warm, and this gave a great many insects a longer time than usual for work. The clover insects have been even worse than they were last year, and much of my time has, according to plans for the season, been devoted to investigations regarding them. Aside from this and a continuation of my study of greenhouse pests, my time has been used in studying or experimenting on what few insects needed special attention on our own grounds, and in answering a large number of letters daily that have come in from people wanting information as to remedies, or identification and habits of certain injurious insects.

CANKER WORMS.

One of the earliest insects to appear this spring was the canker worm, *Paleacrita vernata.* The attack was general in the orchards over the greater part of the State, and whole orchards became entirely stripped of green foliage before the owners were aware of any insect work. A great many letters came to the department asking for help, but almost invariably too late for a reply to be of much assistance, as the trees were then reported as having most of the leaves dead, and the canker worms sent were usually so nearly grown that they were ready to leave the trees and enter the ground to pupate. Canker worms are very easily killed by spraying the trees with one of the arsenites, if spraying is done early while the canker worms are yet young and small, and a heavy rain does not wash the poison off before the young canker worms have a chance to feed on the poisoned foliage.

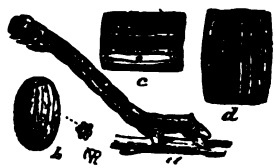

Fig. 1.—Canker worm at *a*; egg of moth, *b*; *c* and *d* are segments of the canker worm enlarged to show color lines.

Our College orchard would have been stripped by them, as were some of the orchards around us, had the trees not been sprayed very early, when the buds were unfolding and when the little canker worms were not larger around than a pin and not a quarter of an inch long. A hard rain came about two days later. The trees sprayed last had not had the poison on them quite twenty-four hours when the rain came and many of the canker worms on these trees were not killed. On the remainder of the orchard the destruction was complete. Many people complain that they cannot succeed with the arsenites against the canker worm, but if they will treat the canker worms early, in favorable weather, with one of the arsenites, at the rate of one pound to two hundred gallons of water, the canker worms will never do any great harm.

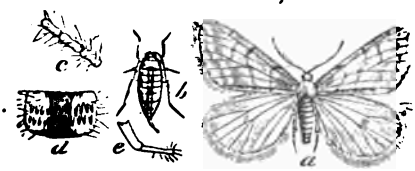

Fig. 2.—*a* is the winged male and *b* the wingless female of the canker worm.

For those who prefer a prevention, bands of wool, tied around the

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trunk of the tree early in the spring before the buds begin to start, will keep the canker worms from the trees, though we often suffer from attacks of a fall canker worm also, in which case the bands will need to be on by the middle of October. The female is wingless and has to climb the trunk of the tree to lay her eggs, and the band should be tied tightly to the tree, but left loose and puffy enough outside to prevent her climbing over.

CLOVER MITE—A HOUSEHOLD PEST.

On the 15th of May a letter was received from Mr. H. C. Lott of Bellaire which is worth recording. It reads as follows:

"DEAR SIR—I send you by this mail specimens of a little pest that appeared last year in our house and since that time have increased in numbers. They do not appear to be injurious, bnt their presence is not desired and no means have yet been found to rid the place of them. Will you please examine them and, if possible, tell me what they are and how they may be destroyed?"

A few questions were asked in my reply, to which Mr. Lott responded with the following:

"* * * * In the first place the house is quite new with no trees or shrubbery near it. Has a lawn in front and faces to the west. In the front part the mites appear mostly on the windows. They seem to be constantly in motion and have no evident means of subsistence. There are plants in another part of the house, but no insects there.

"They are most numerous during warm weather although occasionally one was seen on the window sill during the past winter. They are also found in large numbers on the front fence."

The mites sent by Mr. Lott are the common clover mite, *Bryobia pratensis*. The description of its presence in his house is a very vivid one and shows the annoyance that they may produce in entering a house when migrating in the fall or spring. Their bodies are not larger than a pin head, but they usually come in such countless numbers that their presence is easily known. They are closely related to the red spider that is so common on house plants, and differ in being a darker brownish red and in having the back covered with little corrugated patches. Mites may be known from insects by having eight legs like a spider, instead of six as an insect has.

This species of mite is found all over the northern part of the United States, but is seldom troublesome in houses anywhere except in the middle states. In Michigan it is common on clover and is frequently troublesome in houses where clover is used on the lawn or near the house. Clover is the most common food plant although the mites are known to feed on fruit trees and arbor vitæ. In this individual case the mites had migrated to the house and fence in search of winter protection as soon as the clover had become unpalatable and the weather unpleasant. In the spring when noticed again, they were leaving winter quarters in search of food for the summer.

The mites probably do no real harm, but as it is at least unpleasant to have them occupy rooms with us, it is best to dispose of them as soon as possible. This may easily be done by spraying the outside of the buildings, on which they are found, and the clover near the house, with kerosene emulsion. This spraying may have to be repeated every day or two for a short time as the mites are constantly traveling, but, if persisted in, the mites will soon disappear. If thought best, the rooms inside may be

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sprayed, where the mites are thickest, with benzine. There is no danger in using benzine or gasoline indoors if there is no fire or light near to ignite it, and, when a room is aired after using it, all traces of odor disappear.

THE ARMY WORM.

By the last of June or early July the army worm began to make its appearance, though not in any great numbers, in the southern and central portions of the State. From the 8th to the 15th of July reports began to come in rapidly from St. Clair, Otsego and Montmorency counties, stating that large armies were traveling through the fields and destroying everything before them. It had been such a long time since the army worm had appeared in armies in Michigan, that no one knew what it was or what

FIG. 3.—Army worm and the moth to which it changes, both natural size (after Riley).

to do for it at the time of its appearance. In reply to requests for help, your entomologist was sent to Gaylord and vicinity to aid in checking the invasion and to learn of the breeding grounds if possible. The worst of the invasions were over in that region by the time I arrived, though much of value was learned by going over the devasted regions and in conversation with those who had watched the army worms. The armies were the worst in newly cleared regions, where there were plenty of swamps and waste places that were neither cultivated nor pastured. This served as an excellent breeding ground for them. As the country becomes better cleared and waste places utilized, invasions by the army worm will no doubt become a thing of the past. Around swamps and cat holes, it will be well to guard against future invasions by burning off the dead grass at some convenient time in autumn or spring when grass will burn, but when fire will spread no farther.

While in Otsego County, reports came of invasions in the counties farther north and west. At the same time Wisconsin and some of the adjoining states were suffering from even worse attacks. By the 18th of July the armies had commenced invasion on the upper peninsula, and, before the close of this month had entirely disappeared from our borders.

Quite a number of the army worms were collected while in Otsego County and brought back to the College to rear. Out of perhaps 100 caterpillars only two moths appeared. Instead of moths from the other 98, there came a swarm of large blow flies that had fed as maggots inside the caterpillars and killed them. There were two species of these flies, *Cyrtoneura stabulans*, Fallen, and *Exorista cilliata*, Towns., the former being much the more common. This large number of parasites would indicate quite plainly that there will not be enough of the moths that will appear this fall to lay eggs for an invading army next year.

At the time of the invasion a press bulletin was issued which treats of the life, history, habits, means of prevention, etc., of the army worm, and which will be found elsewhere in this report.

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CLIMBING CUT WORMS.

Every year people in the fruit belts, along the lake shore, suffer more or less from the work of climbing cut worms in their orchards. Early this season we received a number of climbing cut worms from Mr. H. C. Rood of Muskegon, asking what to do for them. His description of their work and great numbers is so graphic that parts of his letter will be given.

He writes, "I send you by mail a box of climbing cut worms, that have been damaging my orchard. They are still at work, but the foliage is so

Fig. 4, *Carneades messoria* in three of its stages; *a*, cut worm, full grown; *b*. moth of same, and *c*, the pupa at the right (after Riley).

large and tough now that they do but little damage. They like the tender buds and shoots, but will eat any thing if they can not get the buds. They are also at work at our grape vines. We have killed as many as 1,500 on some trees; not all in one night, but I did kill on a tree the other night 412 and the next night 114, and the next night 141 on this same tree, at one time, where I had been hunting them for two weeks before. I did not have time to count them very often, as I have between four and five thousand trees. They have ruined a half or two-thirds of my crop. They go straight to the top of a tree and leave the lower limbs. The tops of some of my trees look as though they were dead, while the bottom limbs are white and full of blossoms. They look like a bald-headed man with a fringe of gray hair around the lower part of his head.

"I sprayed the trees twice, as it rained after the first application, and could not see that it did a particle of good. I had no idea that it would, but would try. As for putting a tin collar on the trees, that would hardly be practical, as the trees are not uniform in size and a collar of tin could not be made, except by a professional tinner, to fit each tree, and even then it would not hug the tree close enough, and the cut worms would go under. I tried everything I could think of; but cotton was the best. I put a cotton band around the tree and then killed the worms after dark. As long as the cotton kept dry, it stopped their upward climbing, and there would be a great mass of moving worms just beneath the cotton. After it rained on the cotton, they walked right over it and got in a good night's work. Next day, as I had no more cotton, I put a daub of tar on top of the band. That worked like a charm for a while, but as soon as the tar got cold and lost its smell, they trotted over it and I had to put on another coat. All this time we were killing them off by the thousands, and still not seeming to thin out their ranks.

"My soil is sandy and the orchard has been in clover for the past two years, but the dry weather last summer killed out a good deal of the clover. I have an idea that if the clover had not dried out, the worms would have fed more on it and left the trees. Is clover a good thing for the worms to breed in, and do they breed from themselves or are the eggs laid by a moth or miller? If so, I could trap the moth. If you can post me as to the breeding of these worms or suggest a better remedy than those tried, I shall be very grateful for your help."

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Climbing cut worms feed only at night and bury themselves in the ground through the day. They do not breed to any extent where the soil is not light and sandy, and for this reason the greater part of Michigan is exempt from severe attacks, though very often we find now and then a tree where the buds have been eaten out, and we are unable to account for this mysterious condition of the trees where no insects can be found. We have never suffered from their attacks here at the College, nor in any region where I have been. Fruit growers who do suffer from their attacks, say that they find a better preventive in a band of wool than in the cotton band used by Mr. Rood. Rain on a wool band will not pack the wool like it will cotton. The band should be tied well up on the trunk of the tree and should be tied so that it is very tight and close to the trunk, as the worms can not then crawl under, and left light and fluffy outside to prevent them crawling over. The only fault that is found with the band on a tree is, that the caterpillars, when they cannot crawl over the band, soon become so hungry that they often gnaw the bark off beneath the band and so kill or injure the tree.

Judge Russell, of Hart, thinks that even a better remedy than the wool band is to stick some small limbs, that have been wet with a strong solution of one of the arsenites, in the ground around under the tree close to the trunk. The cut worms will take these limbs in preference to the taller trees and will be killed by the poison. He says that this will not work with all people, as these poisoned limbs must be placed under the trees before the cut worms begin to climb the tree, and many people will postpone this part until too late.

Where the cut worms are very numerous, perhaps a combination of the two might be even better yet for many orchards. The band would be a surety against their climbing the tree and the poisoned buds would be a good bait that would soon kill them off. Poison, on the trees themselves, is too slow in its action on the cut worms to save the trees. If the cut worms are killed, there will be fewer for an attack the next year. Whatever is done, should be done early as the great harm comes when the trees are in the bud. Sometimes the buds are killed and never start again, but Mr. Rood wrote me later that in his orchard the buds had started again. Be that as it may, the fruit buds for the season are usually killed and the life of the tree endangered.

Trapping the moths has been often tried and has generally been given up as useless. Many moths can be caught at night with fires, lantern traps, and by similar methods, but the greater share of the specimens are males, and females that have already laid the most of their eggs, so that in reality the traps have caught only those that we care little for and have not caught the egg-laying females that it was our original plan to catch.

The four species of cut worms, sent by Mr. Rood, are *Mamestra subjuncta*, *Carneades scandens*, *Nephelodes minans*, and *Carneades messoria*. A cut of the last one, in three of its stages, is given to show the transformations passed through by these cut worms. When the cut worms have attained their growth, they measure from an inch to an inch and three-quarters in length. Then they cease feeding, bury themselves in the ground and transform to the chrysalis or pupa stage, as shown at the right hand side In this quiet stage they remain until July or August, or sometimes until the following spring, when they hatch out into dingy moths, resembling closely in size and appearance the one shown at *b*. These moths do not eat as the caterpillars do, but merely sup sweets from flowers,

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at night, resting in some secluded place by day, as did the cut worm. At this time the moths mate and the female soon lays a number of eggs, perhaps from 50 to 200, and then, as her mission is done, she soon dies. These eggs are deposited somewhere near the trees or on the leaves so that, when the young cut worms hatch from them in early spring, they will not have far to go to secure a good supply of food. The young cut worms grow rapidly and soon are matured to again go through with the same cycle of life as that of their ancestors.

BLISTER BEETLES.

Several species of our most common blister beetles have been reported to us the past season as doing considerable injury. The "old fashioned" blister beetle, *Epicauta vittata*, that used to swarm down upon our potato fields in great armies, before the present Colorado potato beetle was known, is one of the number and has returned to its old occupation of stripping potato vines in its same old way. The beetles are half an inch, or a little more, in length and are a yellowish brown with black stripes along the wing covers. Another beetle, that differs only in being black with gray margins on the wing covers, has also done some injury to potatoes in the same way. It is known as *Epicauta cinerea*. This species is not usually as common as the striped one.

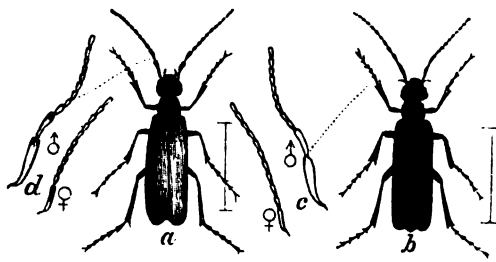

FIG. 5.—Blister beetles with the lines at the right side showing the natural size (after Riley).

A close relative, *Epicauta Pennsylvanica*, according to Mr. Ellis of Bridgeport, has been sampling his sugar beets. He writes:

"The enclosed are some insects that I gathered from my sugar beets. They are quite numerous and are eating the leaves quite badly. I first noticed them about the last of July. We have always raised beets but never saw an enemy of any kind on them before. Paris green will kill them. I put it on with plaster in the proportion of three pounds to a barrel of plaster and began to see the effect in about nine hours after dusting. Would like to know what they are and if prevalent in other parts of the State." This beetle is entirely black and somewhat smaller than the one first mentioned. It is quite a common beetle, but one that is not generally considered injurious.

Still another, a gray species, *Macrobasis unicolor*, has been destroying Windsor beans at Ortonville. Mr. Hummer writes, "Can you give me any information regarding the insects that I mail today in a small tin box. They appeared yesterday in quantities on the Windsor beans and are eating them up. The beans were destroyed last year by the same insect. If they should prove to be as destructive to other plants as they are to this one, they will be a much dreaded enemy to gardens. I think they disappear as suddenly as they come."

Mr. Hummer is right in this last observation as they appear very suddenly and disappear just as quickly. It is a family characteristic. It is more marked, however, in the first two species mentioned, than in the others, as they often rise from a field like a flock of birds and fly to a neighboring field. They can often be driven from a potato patch like a drove of turkeys by sweeping the tops along one side with a small limb

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from an adjoining tree. They are often driven into straw, scattered just outside of the patch, which is then set on fire and burned.

Mr. Ellis is also right in his statement that Paris green will kill them, though it is slow in its effect. Very often it is too slow to be a practical remedy as the beetles, when they come in such swarms, will nearly strip a field before the poison takes effect. When the beetles do not come in such droves, this is perhaps our best remedy. It may be applied as Mr. Ellis suggests, or better even will be the use of air slaked lime and enough Paris green added to give the lime a faint green tinge. This will be stronger, and the lime will prevent the burning of the foliage. If a spray is used, make the strength at the rate of one pound to 100 gallons of water and add several pounds of fresh slaked lime to each barrel used, and the effect on the vines will thus be neutralized.

A few years ago we were troubled with these blister beetles on sunflowers and we tried a spray of kerosene emulsion on them with good success. In the use of the emulsion, each beetle must be well wet with the mixture, or it will survive. If a part of them are killed in this way, the survivors will usually leave.

In their early or larval stages, these blister beetles are seldom seen and many of them are unknown. Some of them are parasitic on honey bees by crawling onto them when they are gathering pollen and honey. Others are parasitic on grasshopper eggs and so are rather beneficial than hurtful. The above cut of one of the species will give the reader a good idea of the general appearance of all of them.

Many other insects have appeared through the season, but these already given are perhaps the more important ones, of those that are not present with us every year and generally well known. There have been several new and heretofore unknown injurious insects this season that have not as yet been treated of. A paper on this theme was read before the American Association of Economic Entomologists which met recently at Brooklyn, New York. As these species rightfully belong in this report on the season's work, the following paper will be included in the report.

SPECIAL ECONOMIC INSECTS OF THE SEASON.

One can hardly fail to learn some new facts regarding insects in an economic line through his correspondence for the year. This season I have found several such instances which I have endeavored to bring together in this brief paper. The work of the species may not be entirely unknown, but such habits at least are not generally known and are entirely new to myself and unknown to others as far as my search has gone in economic literature.

The first species of which I shall treat is the Scarabæid,

DIPLOTAXIS HARPERI, AS A STRAWBERRY PEST.

Specimens came to me May 24 from Campbellsburg, Indiana, through the *Practical Farmer and Fruit Grower*, of Grand Rapids. The accompanying letter from Mr. Brown stated that they were injuring his strawberries and had already done some injury to his wheat. He also said that they attacked the smaller and weaker plants over his two and a half acre field of berry plants and very quickly destroyed them.

A subsequent letter explained that the beetles remained about three weeks. They fed at night, and in the day time buried themselves an inch or two below the surface of the ground. As high as two dozen specimens

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were found at a time on a single plant. The beetles appeared in the wheat first, but, as it became too tough, they migrated to the newly set strawberry field near by. An old strawberry patch adjoining this one was unharmed. The soil is a light clay loam. The beetles were not noticed to appear in any one place, but seemed to be equally distributed over the whole piece. Paris green was tried but with no evident effect.

The species is closely allied to our common May beetle, *Lachnosterna fusca*, and its nocturnal habits seem to be the same. The form is that of Lachnosterna, but the body is not much larger than that of the rose chafer. Our College collection contains specimens from Michigan, Illinois and District of Columbia.

A DIPTERON RASPBERRY GIRDLER.

Early in May a letter from a Lansing fruitgrower reached me, and from which the following is taken: "A few days ago I noticed that some of the young shoots of my raspberry canes were withering. On examination I found the cause to be a small worm, or grub, about an eighth of an inch long and as large as a small needle. It seems to enter the shoot at the tip and work its way downward for several inches and then make a complete circle near the outside of the shoot so close to the bark that it can be distinguished by close inspection without breaking the shoot. Here the worm is found, and of course the shoot dies."

The next day the berry patch was visited and I found that about half of the young shoots of the black varieties had already been destroyed by the maggot. The keeper had guarded the field closely and, as soon as a shoot wilted, had broken the stems off and burned them. In fact he had been so vigilant in the work that I was able to secure but few specimens for myself. At this time the maggots were about 5 mm. long; white, with black jaws; truncated posteriorly, and sloping gradually to a pointed head. In general appearance they resemble very closely the larvæ of the Anthomyiadæ.

They worked only on the young shoots of the black varieties of raspberries. They entered near the top of the shoot in a leaf axil, which probably was the top bud when the egg was laid. From this entrance they worked their way, in an irregular course, down through the pith until within a few inches of the ground when they girdle the cane as represented in the extract. As soon as the top wilts the maggot continues its course downward through the pith.

Careful search was made in neighboring berry patches and in our own at the College, but nothing more of the kind was found. Not so much would have been thought of this one local injury, had there not come a letter from Costillo, Pennsylvania, through the *Practical Farmer and Fruit Grower*, about two weeks later, describing the work of the maggot exactly at that place. The letter stated that the injury was considerable in that locality. This led me to think that perhaps the species is more widespread than at first thought. Every effort was made to rear the maggots which I had, and I was successful for some time by transferring them every few days to fresh shoots. The last maggot reached a length of 11 mm. when it died. I have it here before you, hoping that some one in the assembly has had better success than I and can tell its name and more regarding it. [After the paper was read, Mr. Hopkins, entomologist of West Virginia, said that he had found the same insect on raspberry shoots in West Virginia, but had not succeeded in rearing it.]

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ADIMONIA CAVICOLLIS ON CHERRY FOLIAGE.

A correspondent at Bellaire, Mich., sent me specimens of this Chrysomelid the latter part of May, saying that they were causing damage to cherry trees in that locality. On investigating the life history of the species, I find that it is reported by Packard in "Forest Insects" under *Galeruca sanguinea*, as found abundant in New Hampshire on wild cherry. Like so many other insects that we find each year, the Adimonia has in some way found that a cultivated plant closely related to its old food plant, is preferable and is making the most of its newly found plant. The beetle is spoken of by Schwarz, "*Insect Life*" IV, p. 94, as being a common northern species, and we may yet have quite a serious pest in these cherry leaf eaters.

I wrote to Bellaire telling Mr. Jones that the beetles worked on wild cherry and asked if there were any of the trees in the neighborhood. I also asked him to watch for larvæ of the beetles. He replied that there were wild cherry trees not far away and, on further examination, found a few of the beetles on them. On the tenth of July, a box of larvæ arrived. It was at the time of strikes when mails were uncertain, and the box was so long in reaching us that the larvæ were nearly dead and never survived.

The larvæ sent are about 5 mm. long; not very broad, and tapering posteriorly. Head, legs, pronotum and terminal plate black in all the specimens except one which is larger, and these parts in that one are reddish brown. On the dorsum of each segment are two transverse, rectangular, parallel, dark spots with two or more smaller ones on the sides at the end of the larger ones, and beneath these is a longitudinal block on each segment. The venter of each abdominal segment is marked with five dark brown spots, the central one being largest.

NOTOXUS ANCHORIA EATING CHERRIES.

In connection with the Adimonia, this species of Notoxus might be mentioned. It was reported from northern Michigan as collecting in large numbers on nearly ripe cherries and eating the contents from them. It is quite probable that the species was not the direct cause of the injury, but ate the fruit after it was punctured in some other way.

MONONYCHUS VULPECULUS DESTROYNIG IRIS FLOWERS.

This Curculionid destroyed the flowers in a bed of Iris plants at Flint, Michigan. The beetles ate little holes over each carolla as it appeared, and soon killed it. The beetles showed a preference for the white and lavender varieties of the Iris. No other kind of flowers outside of the bed were molested. The beetles remained for some time, but nothing more has been learned as to their work or habits.

Respectfully submitted,

G. C. DAVIS,
Consulting Entomologist.

AGRICULTURAL COLLEGE, MICH.,
June 30, 1894.

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REPORT OF THE CHEMIST.

To the Director:

SIR—I submit the following observations:

HOURS OF SUNSHINE.

The following table of hours of sunshine at the Agricultural College is offered as a contribution to the physics of agriculture. It will also be of interest from the relation of sunshine to human and animal health. The observations were made with Pickering's sunshine recorders.

Hours of sunshine daily at Agricultural College for 1893.

Day of month.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
1	0	0	11½	2½	0	0	0	14¼	13	11¾	10½	1
2	1	0	5¾	6¼	5½	1½	13	14¼	11¾	11¾	0	0
3	0	2	6¾	2½	11¼	0	15	14¼	13	0	10½	0
4	0	8	5¾	12¾	12½	12	7½	14¼	13	8	10½	9½
5	0	3	11½	12¾	12½	7½	14¾	5½	13	11¾	10½	1
6	6	0	11½	2½	14	4½	0	14¼	11¾	1	10½	1
7	5	6	11½	1¼	14	13½	9	14¼	13	8	10½	9
8	3	5	0	7½	14	12	14¾	14¼	13	5½	10	9
9	0	0	9	9¼	14	9	11¾	14¼	12½	11	0	0
10	5	6	3¼	1¼	14	13½	14¾	14¼	12½	11	5	0
11	5	8½	4½	3¾	0	15	13½	14¼	12½	11	0	0
12	2	10½	5¾	1¼	3	15	14¾	14¼	0	11	0	1
13	3	10½	0	0	11¼	15	7¼	14	0	0	5	2
14	3	0	0	0	12½	12	8¼	14	1½	0	4	0
15	0	0	8	9	1½	12	7¼	14	0	4½	1	0
16	0	8½	9¼	6½	11¼	9	7¼	0	0	11	10	0
17	8	3¼	11½	7¾	11¾	15	14½	0	1½	11	9	4½
18	10	0	1¼	5	14½	15	14½	7	0	11	3	4¾
19	0	0	6	0	14¾	15	14½	8½	12½	9	9	0
20	10	9½	0	0	14¾	7	14½	11	1½	2¼	8	8¾
21	5	0	12	0	14¾	12	14½	7	2½	11	0	8
22	5½	5½	0	0	14¾	12½	12½	12½	12½	11	0	0
23	2½	0	0	0	11¾	12½	14¼	14	12½	1	0	9
24	8¾	8½	12	0	7½	12½	14¼	13	9½	9	3	4½
25	2½	4¼	8½	0	14¾	12	14¼	13	12	10½	7¾	0
26	0	11	9½	0	11¾	12½	14¼	13	12	0	2	0
27	0	4	12½	5	14¾	15	14¼	10½	12	3	0	3½
28	9	11	12½	1¼	1½	15	14¼	6½	12	0	0	0
29	0	.....	10	0	11¾	15	14¼	10½	13	5¼	0	0
30	0	.....	12½	0	14¾	12½	14¼	13	0	4	2	1
31	.....	.....	12½	.....	8¼	.....	14¼	13	.....	5¼	.....	3¾
Totals	94¼	125	224½	98	373	335	372	356¾	258	210½	142¾	81¾

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SUNSHINE TEMPERATURES:—*Record of maximum and minimum thermometers at Agricultural College, Michigan, 1893.*

Day of month.	January.		February.		March.		April.		May.		June.		July.		August.		September.		October.		November.		December.	
	Maximum in vacuum.	Minimum in air.	Maximum in vacuum.	Minimum in air.	Maximum in vacuum.	Minimum in air.	Maximum in vacuum.	Minimum in air.	Maximum in vacuum.	Minimum in air.	Maximum in vacuum.	Minimum in air.	Maximum in vacuum.	Minimum in air.	Maximum in vacuum.	Minimum in air.	Maximum in vacuum.	Minimum in air.	Maximum in vacuum.	Minimum in air.	Maximum in vacuum.	Minimum in air.	Maximum in vacuum.	Minimum in air.
1	47	23	50	3	114	10	122	21	85	42	137	58	125	55	147	44	141	35	123	47	123	43	98	6
2	61	-12	46	10	100	28	90	40	110	37	139	62	148	56	152	50	134	46	134	55	100	27	45	11
3	45	2	103	-7	137	10	99	43	115	35	140	67	137	46	157	55	139	47	89	40	105	20	70	-10
4	43	-8	103	5	130	9	120	30	114	34	143	65	146	55	147	57	135	48	124	41	110	21	105	11
5	90	-9	108	35	110	10	121	31	98	33	137	60	148	58	150	54	140	43	126	44	107	25	72	15
6	108	10	103	3	137	26	135	35	130	39	134	50	97	57	150	41	130	57	104	44	114	24	75	9
7	105	-6	93	0	103	27	120	50	130	39	146	55	142	78	140	42	136	40	122	52	112	33	82	14
8	80	20	98	12	75	38	132	32	129	45	137	55	140	57	145	46	142	47	117	57	106	25	85	18
9	53	-18	68	30	112	42	132	48	130	48	137	55	146	52	148	52	140	42	127	44	78	30	89	25
10	92	-4	72	20	108	37	125	35	131	54	138	51	149	52	149	62	130	44	127	45	108	28	44	2
11	46	-11	120	12	121	44	120	40	140	60	140	51	145	63	142	58	139	55	128	49	97	33	38	12
12	48	-4	145	8	96	32	131	40	128	57	135	52	149	69	149	42	115	63	132	44	87	34	56	-11
13	60	-4	139	22	99	31	120	42	129	49	137	54	146	69	151	45	101	64	80	39	106	28	58	-2
14	92	-7	70	33	90	6	114	40	128	44	148	58	146	67	143	44	136	58	74	25	100	20	58	32
15	93	-10	80	24	148	6	135	28	139	43	146	52	153	65	162	58	131	47	80	20	89	6	51	30
16	60	-6	112	9	107	17	114	34	123	47	149	63	152	60	94	60	120	33	104	25	110	30	34	23
17	65	-4	110	11	108	15	125	33	135	48	142	58	144	55	148	50	119	55	119	36	80	22	80	12
18	92	-2	104	-11	120	20	98	34	129	40	146	64	147	53	145	47	127	59	124	35	100	22	91	14
19	65	-10	80	-19	112	25	90	35	125	62	143	68	145	52	137	51	128	44	126	40	110	25	54	4
20	103	-8	114	-2	94	30	87	39	139	49	145	63	149	53	149	48	131	45	100	30	95	27	116	17
21	96	0	51	4	124	24	85	33	141	49	145	67	147	54	147	48	135	62	110	33	42	32	101	28
22	60	21	130	20	85	29	92	33	140	60	143	54	150	45	150	55	134	47	120	33	42	25	60	37
23	83	13	70	18	105	41	93	35	110	37	145	54	150	55	165	55	129	32	140	33	50	18	102	30
24	50	15	124	18	117	20	85	35	137	53	142	54	140	57	147	60	123	43	103	23	50	15	103	50
25	64	15	125	6	101	27	87	31	120	42	145	55	152	67	149	50	116	27	107	35	56	9	90	38
26	75	0	135	18	110	22	105	37	128	40	145	56	143	42	150	55	123	27	91	38	57	33	89	20
27	53	25	90	30	108	22	124	35	135	47	145	55	152	55	149	60	133	26	101	29	42	31	91	28
28	55	28	114	28	105	25	120	37	112	49	145	58	136	59	145	55	120	20	104	30	43	33	55	27
29	95	12	.....	.....	110	35	85	35	137	47	146	55	150	51	140	35	121	40	103	20	46	26	45	17
30	90	15	.....	.....	120	32	110	37	133	50	145	61	151	57	139	39	60	45	80	27	87	13	66	15
31	75	25	.....	.....	110	37	.....	.....	134	55	.....	.....	146	45	130	42	.....	.....	106	36	.....	.....	89	6
Means	73.3	2.6	97.9	12.1	110.2	24.7	110.5	35.8	126.6	46.2	140.8	57.5	144.2	56.4	145.6	50.5	126.9	44.5	110.3	36.6	84.7	25.3	75.9	17.1

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SUNSHINE TEMPERATURES.

The preceding table gives the maximum daily temperature as marked by a solar vacuum thermometer (bulb covered with lamp black) freely exposed to the sun, and placed on a grass plat, away from buildings, and six inches above the grass. The minimum temperature is determined by a minimum thermometer with similar exposure and elevation. The temperatures were read off at 7:00 a. m. for the preceding day's observation.

The excessive temperature marked by the solar maximum thermometer (in vacuo) would seem at first sight to be of little value in estimating the agricultural meteorological conditions of a district, yet a comparison of many different localities by this method may develop facts of value. It is offered as a contribution to agricultural climatology.

TEMPERATURE OF RIVER WATER.

The temperature of river water where the stream is bordered by forest growth, and the water for much of the season is derived from springs, will afford a possible measure of the march of the season, provided that the temperature is taken at definite periods of the season and at the same hour of the day. The temperature of the water in Red Cedar river as it flows through the College grounds has been taken for some years on the first day of the month, and at 9 o'clock a. m.

When the river was covered with ice, no record was made, for obvious reasons.

The temperature of the water in Red Cedar river in the College grounds, taken on the first day of each month at 9 o'clock a. m. for the years indicated.

Months.	1886.	1887.	1888.	1889.	1890.	1891.	1892.	1893.	Average for eight years.
April	40	38	40	40	37	41	40	32	38.50
May	55	49	53	52	54	59	59	47	53.50
June	63½	65	61	48	62	69	71	66	63.18
July	77	77	76	75	76	71	66	69	73.37
August	66	77	74	70	75	68½	69.8	68	71.00
September	66	69	64	70	63	64½	62.6	64	65.38
October	52	55	52	57	55	61	54.5	49	54.44
November	49	37	52	44	41	42	44.6	42	43.95
December	Frozen	Frozen	35	Frozen	36	32	37.4	Frozen	.....

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SUMMARY OF METEOROLOGICAL OBSERVATIONS AT THE MICHIGAN AGRICULTURAL EXPERIMENT STATION FOR THE YEAR 1893.

IN CONTINUATION OF THE SAME SERIES OF OBSERVATIONS RECORDED FOR THE MICHIGAN AGRICULTURAL COLLEGE SINCE 1863.

BY R. C. KEDZIE, PROFESSOR OF CHEMISTRY AND CHEMIST OF THE STATION.

[Latitude 42° 43' 56'', longitude 7° 25' 59.61'', height above sea, 834 feet.]

Months, 1893.	Mean daily temperature in open air.	Percentage of humidity, saturation = 100.	Pressure of vapor of water.	Height of barometer, reduced to temperature of 32° F.	Percentage of cloudiness.	Self registering thermometers.		Amount of rain or melted snow in inches.	Snowfall in inches.	Number of thunderstorms.
						Maximum.	Minimum.			
January	14°.8	82.26	.062	29.008	77.9	22°	4.77	1.78	18.75	----
February	21 .31	87.2	.098	29.115	66.8	31 .2	11.9	1.83	17 5	----
March	28 .16	85.3	.148	29.063	56.7	43 .8	24.1	2.92	6.	2
April	43 .5	74.5	.228	28.978	70.6	51 .2	35.1	4.81	----	5
May	54 .4	74.5	.316	28.984	51.6	64 .3	45.5	2.86	----	2
June	66 .6	77.6	.532	28.767	39.6	80	58.1	4.85	----	8
July	71 .5	75.1	.571	29.069	38.6	83 .4	57.5	1.86	----	4
August	68 .1	77.6	.537	29.119	31.0	82 .7	52.9	.56	----	1
September	58 .4	87.7	.468	28.993	41.7	74 .1	45.	1.84	----	2
October	49 .7	80.7	.311	28.980	44.6	61 .5	37.6	3.61	----	1
November	35 .63	86.7	.183	28.998	61.5	43 .7	23.1	2.19	3.	----
December	27 .60	83.3	.294	28.984	78.7	34 .6	16.	2.28	13.1	----
Year	44°.97	81.04	.313	29.006	54.8	56°.04	34.29	31.29	58.35	25

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METEOROLOGICAL OBSERVATIONS FOR THE MONTH OF

Day of month.	Thermometer in open air.				Relative humidity, or per cent of saturation.			Pressure of vapor in inches.			Barometer reduced to freezing point.			
	7 A. M.	2 P. M.	9 P. M.	Daily mean.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.	Mean.
1	28	31	31	30	88	89	89	.135	.155	.155	28.444	28.449	28.498	28.462
2	26	25	15	22	100	100	82	.141	.125	.070	28.767	28.804	28.853	28.808
3	9	15	11	11⅝	77	64	79	.051	.055	.057	28.977	28.937	28.876	28.930
4	6	12	6	8	75	60	51	.043	.045	.029	28.783	28.655	27.618	28.668
5	14	19	10	14⅓	81	100	87	.067	.103	.025	28.417	28.468	28.941	28.608
6	—3	22	16	11⅝	67	71	88	.027	.084	.074	29.034	29.045	29.106	29.061
7	13	20	15	16	100	70	100	.078	.075	.086	29.110	29.078	29.083	29.090
8	9	24	18	17	100	100	100	.065	.129	.098	28.991	28.952	28.452	28.801
9	20	19	4	14⅔	85	69	73	.091	.071	.088	28.325	28.370	28.607	28.434
10	—11	6	—4	—3	100	75	39	.027	.043	.017	28.817	28.858	28.970	28.880
11	—2	7	4	3	67	76	73	.027	.045	.038	29.018	28.897	28.777	28.897
12	4	18	9	10⅓	100	84	77	.052	.082	.051	28.761	28.773	28.813	28.782
13	—2	13	5	5⅓	100	81	100	.040	.068	.055	28.878	28.912	28.945	28.912
14	—6	5	—6	—2⅓	65	100	100	.024	.055	.033	29.014	28.976	29.010	29.000
15	—3	2	—3	—1⅓	100	71	100	.038	.034	.038	29.071	29.078	29.124	29.091
16	—2	11	4	4⅓	100	79	73	.040	.057	.038	29.228	29.267	29.295	29.266
17	5	10	7	7½	74	57	76	.041	.069	.045	29.349	29.321	29.184	29.285
18	15	27	4	15⅓	100	100	73	.086	.147	.038	29.061	28.991	29.116	29.056
19	—5	20	12	9	87	85	80	.015	.091	.060	29.180	29.199	29.209	29.196
20	18	24	16	19⅓	84	86	83	.082	.111	.074	29.241	29.237	29.202	29.226
21	13	23	20	18⅔	81	59	70	.063	.073	.075	29.202	29.218	29.220	29.213
22	23	31	26	26⅓	100	100	75	.123	.174	.105	29.100	29.100	29.057	29.085
23	25	33	28	28⅔	100	89	88	.135	.168	.135	29.011	29.021	29.078	29.036
24	22	25	25	24	86	49	100	.101	.066	.135	29.090	28.980	28.801	28.957
25	20	27	22	23	85	75	86	.091	.111	.101	29.173	29.224	29.161	29.186
26	24	25	21	23⅓	73	74	85	.094	.100	.096	29.100	29.172	29.309	29.193
27	5	17	17	13	74	67	100	.041	.063	.094	29.377	29.367	29.260	29.268
28	31	43	41	38⅓	89	100	100	.155	.278	.257	29.083	28.998	28.926	28.985
29	25	23	15	21	74	59	82	.100	.073	.070	29.264	29.376	29.418	29.352
30	16	25	21	20⅔	83	100	56	.074	.135	.064	29.352	29.208	29 229	29.263
31	20	27	32	26⅓	70	100	100	.075	.147	.181	29.300	29.166	28.974	29.146
Sums														
Means				14.8	84.3	81.6	80.9	.072	.097	.078				29.008
Average						82.26			.082					

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JANUARY, 1893, AT AGRICULTURAL COLLEGE, MICHIGAN.

Clouds.						Winds.						Registering thermom'r.		Rain and snow.			
7 A. M.		2 P. M.		9 P. M.		7 A. M.		2 P. M.		9 P. M.							
Per cent of cloud.	Kind.	Per cent of cloud.	Kind.	Per cent of cloud.	Kind.	Direction.	Force.	Direction.	Force.	Direction.	Force.	Maximum.	Minimum.	Beginning rain or snow.	Ending rain or snow.	Inches of rain or melted snow.	Depth of snow, inches.
100	St.	100	St.	100	St.	n w	2	n w	9	n w	7	31	14	In night.	2 P. M.	.23	3
100	St.	100	St.	100	St.	n w	6	w	11	n	8	31	—4				
100	Cu. St.	100	St.	100	St.	w	3	n w	4	w	2	12	4		In night.	.10	3
100	St.	90	St.	00		n w	3	n e	3	w	1	16	—6				
100	St.	100	St.	00		n w	6	n w	11	n w	8	20	—5				
10	Cu.	100	St.	100	St.	n w	3	w	8	w	5	22	0				
100	St.	00		100	St.	s w	1	w	3	w	5	22	—1				
00		100	Cu.	100	St.	w	8	s w	9	s w	7	27	12		In night.	.20	4
100	St.	100	St.	00		s w	1	n w	2	n w	6	20	—12				
00		10	St.	10	St.	n	1	n w	8	w	3	6	—11				
100	St.	100	St.	100	Nim.	s w	10	s e	12	s e	9	7	—4	2 P. M.	10 P. M.	.21	2
100	Nim.	60	Cir. St.	40	St.	n e	4	n w	3		0	18	—4				
90	St.	80	Cu.	100	St.	n w	2	w	3	w	7	16	—10				
100	St.	100	Cir. St.	00		s w	5	s	6		0	6	—16				
100	St.	100	St.	100	St.	s w	3	s w	6	s w	10	2	—9				
100	St.	100	St.	100	St.	s w	5	s w	10	s w	10	7	0				
100	St.	100	Cu.	5	St.	s w	7	s e	12	s e	8	14	1				
100	St.	100	St.	00		e	8	n e	13	n w	4	25	—6	7 P. M.	8 P. M.	.08	⅛
00		00		00		n	1	n w	7	n w	2	21	4				
100	St.	100	St.	00		w	1	w	9	w	5	22	8				
90	Cu.	90	Cir.	00		n	2	s e	4	s e	3	28	19				
100	Cu.	100	Cu.	100	St.	s w	4	s w	9	s w	6	30	23				
100	St.	100	Cu. St.	90	Cir.	s w	2	w	4	n	6	32	15				
100	St.	100	St.	100	St.	s w	4	s e	9	s e	2	24	17	8 A. M.	7 P. M.	.28	4
100	St.	90	Cu. St.	100	St.	n w	4	n w	3	e	6	30	16				
100	St.	100	St.	100	St.	n w	4	n w	9	n e	4	30	3				
100	St.	100	St.	100	St.	e	3	e	4	e	8	20	17	In night.			⅛
90	Cu.	100	St.	100	Cir. St.	e	6	e	16	s w	11	45	25	11 A. M.	9 P. M.	.39	
100	St.	00		10	Cir.	w	15	w	3	w	2	25	15				
100	St.	100	St.	100	Cu. St.	s e	7	s e	5	s e	3	28	18	Night.			2
100	St.	100	St.	100	St.	s e	5	s e	22	s w	6	34	25		In night.	.29	
																1.78	18⅛
86.4		84.5		63.0								22	4.77				
77.9%																	

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METEOROLOGICAL OBSERVATIONS FOR THE MONTH OF

Day of month.	Thermometer in open air.				Relative humidity or per cent of saturation.			Pressure of vapor, in inches.			Barometer reduced to freezing point.			
	7 A. M.	2 P. M.	9 P. M.	Daily mean.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.	Mean.
1	31	26	10	22⅓	89	87	57	.155	.123	.089	29.106	29.320	29.567	29.331
2	5	14	19	12⅝	74	81	84	.041	.087	.087	29.521	29.401	29.619	29.514
3	23	22	−7	17⅓	86	70	52	.106	.075	.081	29.214	29.394	29.630	29.412
4	−10	10	5	1⅝	58	57	52	.018	.039	.081	29.879	29.816	29.816	29.837
5	12	30	26	26	60	100	100	.045	.167	.212	29.548	29.273	29.061	29.294
6	28	37	19	31⅓	100	100	84	.229	.221	.087	28.915	28.801	29.096	28.937
7	3	14	6	7⅝	100	100	100	.050	.082	.057	29.424	29.531	29.651	29.535
8	3	12	17	10⅝	72	60	83	.036	.045	.078	29.661	29.630	29.464	29.585
9	21	30	34	28⅓	100	100	100	.113	.167	.196	29.293	28.990	28.785	29.023
10	29	32	15	25⅓	100	89	100	.160	.162	.194	28.722	28.998	29.231	28.983
11	15	30	17	20⅝	82	100	100	.070	.167	.194	29.295	29.306	29.381	29.326
12	20	30	20	23⅓	70	78	85	.075	.130	.091	29.395	29.465	29.389	29.413
13	10	35	28	24⅓	100	70	100	.068	.142	.153	29.376	29.329	29.279	29.328
14	34	38	28	36⅝	89	100	100	.175	.229	.229	29.192	29.058	28.988	29.079
15	34	34	24	30⅝	89	89	86	.175	.175	.111	29.139	29.204	29.175	29.172
16	19	28	17	18	84	88	100	.087	.135	.094	29.211	29.294	29.221	29.242
17	12	17	17	15⅓	100	100	83	.075	.094	.078	29.207	28.902	28.755	28.955
18	19	27	17	17⅝	100	88	88	.103	.129	.078	28.365	28.891	28.420	28.559
19	22	26	2	16⅝	86	100	100	.101	.141	.048	28.471	28.496	28.420	28.462
20	−5	10	2	2⅓	100	78	100	.035	.054	.048	29.079	29.232	29.207	29.173
21	5	21	15	13⅝	74	100	100	.041	.113	.086	29.038	28.897	28.852	28.929
22	12	31	22	21⅝	80	89	100	.060	.155	.118	28 948	28.995	28.998	28.980
23	22	27	26	25	100	100	100	.118	.147	.141	28.768	28.533	28.502	28.601
24	15	28	20	21	64	76	70	.055	.117	.075	28.784	28.868	28.888	28.847
25	23	30	18	23⅓	100	78	100	.123	.130	.098	28.875	28.895	28.832	28.867
26	18	30	21	23	100	89	85	.098	.148	.096	29.019	29.066	29.204	29.106
27	19	39	34	30½	100	46	79	.103	.110	.155	29.139	29.098	28.917	29.106
28	32	31	24	29	100	89	73	.131	.155	.094	28.719	28.904	29.068	28.895
Sums														
Means				21.31	87.7	86.2	87.7	.093	.096	.107				29.115
Average						87.2			.098					

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FEBRUARY, 1893, AT AGRICULTURAL COLLEGE, MICHIGAN.

Clouds.						Winds.						Registering thermometer.		Rain and snow.			
7 A. M.		2 P. M.		9 P. M.		7 A. M.		2 P. M.		9 P. M.							
Per cent of cloud.	Kind.	Per cent of cloud.	Kind.	Per cent of cloud.	Kind.	Direction.	Force.	Direction.	Force.	Direction.	Force.	Maximum.	Minimum.	Beginning, rain or snow.	Ending, rain or snow.	Inches of rain or melted snow.	Depth of snow, inches.
100	St.	100	St.	90	Cu. St.	s w	5	n w	5	n w	6	30	3	9 A. M.	3 P. M.	.....	½
100	St.	100	St.	100	St.	n e	3	n e	7	e	2	35	12	.....	.....	.....	.....
100	St.	90	Cu. St.	00	.....	s w	18	s w	22	w	9	22	—8	11 A. M.	3 P. M.	.38	3
00	.....	10	Cir.	00	.....	w	1	w	4	s e	8	30	5	.....	.....	.....	.....
00	.....	40	Cu.	100	St.	s e	11	s e	12	s	12	37	28	3 P. M.	.....	.....	.....
100	St.	100	St.	100	St.	s	6	w	9	n w	9	27	3	.....	5 P. M.	.50	.....
00	.....	100	St.	100	St.	w	7	n w	15	n w	11	14	0	.....	.....	.....	.....
100	St.	20	Cu.	100	St.	n w	9	w	15	s w	6	21	15	.....	.....	.....	.....
100	St.	100	St.	100	St.	s e	10	s e	11	s e	7	35	21	9 A. M.	In night	.25	3
100	St.	90	Cu.	100	Cu.	w	17	n w	10	n w	3	33	13	.....	.....	.....	.....
00	.....	100	St.	100	Cu.	n	2	n e	5	n w	1	34	12	.....	.....	.....	.....
00	.....	.....	.....	00	.....	w	1	w	5	w	4	40	9	.....	.....	.....	.....
00	.....	.....	.....	100	St.	w	1	w	2	s e	5	42	26	All day		.07	.....
100	St.	100	St.	100	St.	s e	1	s e	13	s w	9	38	33	.....	.....	.....	.....
100	St.	100	St.	00	.....	s w	5	s w	8	s w	6	34	18	.....	.....	.....	.....
20	Cir. St.	90	Cu. St.	00	.....	n w	2	n e	6	n e	2	34	9	.....	.....	.....	.....
100	Cu.	100	Cu.	100	St.	n e	2	n e	6	n e	5	20	11	Snow	.....	.17	4
100	St.	40	Cu.	100	St.	s w	7	n w	14	n w	11	32	11	.....	.....	.....	.....
100	St.	100	St.	00	.....	n w	18	n w	19	n w	10	30	—10	.....	.....	.....	.....
00	.....	00	.....	00	.....	n w	3	w	5	w	3	12	—2	.....	.....	.....	.....
10	Cir. St.	100	Cir. St.	40	Cir. St.	s e	3	s e	7	n e	2	21	4	.....	.....	.....	.....
100	St.	100	St.	100	St.	n w	2	n w	10	ne	6	35	20	.....	.....	.....	.....
100	St.	100	St.	100	St.	s e	10	s e	7	n e	2	27	12	Snow	all day	.37	4½
100	Cir. Cu.	50	Cu.	00	.....	n e	1	....	0	s e	1	34	18	In	night.	.06	2½
100	St.	90	Cir. St.	100	Cu.	w	1	n w	13	n w	10	31	6	.....	.....	.....	.....
10	Cu. St.	20	Cu. St.	10	Cir. Cu.	s w	6	s w	4	s e	3	33	17	.....	.....	.....	.....
60	Cu. St.	00	.....	100	St.	s e	7	s e	17	s e	20	41	25	.....	.....	.....	.....
100	St.	80	Cu.	80	Cu.	s e	23	s w	24	w	17	38	24	.....	.....	.....	.....
----	-----	----	-----	----	-----	----	----	----	----	----	----	-----	-----	-----	-----	1.83	17.5
64	.....	67	.....	68	.....	----	----	----	----	----	----	31.2	11.9	.....	.....	.....	.....
66.3%						----	----	----	----	----	----	-----	-----	-----	-----	-----	-----

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METEOROLOGICAL OBSERVATIONS FOR THE MONTH OF

Day of month.	Thermometer, in open air.				Relative humidity, or per cent of saturation.			Pressure of vapor, in inches.			Barometer, reduced to freezing point.			
	7 A. M.	2 P. M.	9 P. M.	Daily Mean.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.	Mean.
1	22	32	20	24⅔	71	79	85	.084	.143	.091	29.061	29.055	29.144	29.093
2	10	39	30	26⅓	78	63	100	.054	.152	.167	29.166	29.046	28.966	29.059
3	26	30	8	21⅓	87	100	77	.123	.167	.048	28.881	28.886	28.938	28.901
4	12	14	9	11⅔	80	81	56	.060	.067	.036	28.974	29.111	29.168	29.074
5	21	27	10	19⅓	100	100	78	.113	.147	.054	29.204	29.127	29.201	29.177
6	6	33	28	22⅓	75	70	76	.043	.131	.117	29.180	29.138	29.054	29.124
7	26	44	26	32	87	68	87	.123	.196	.123	28.972	29.003	29.027	29.001
8	32	43	42	39	89	100	100	.162	.278	.267	28.972	28.830	28.808	28.808
9	39	47	45	43⅔	100	85	84	.238	.278	.251	28.571	28.728	28.912	28.737
10	35	44	41	40	90	84	91	.183	.241	.235	29.110	29.062	28.914	29.028
11	43	51	37	43⅔	92	79	81	.254	.296	.178	28.700	28.618	28.653	28.657
12	45	36	33	38	100	80	89	.300	.170	.168	28.914	29.014	28.997	28.975
13	32	44	41	39	100	84	82	.181	.241	.212	28.911	28.856	28.723	28.830
14	31	31	15	25⅔	100	100	100	.174	.174	.086	28.736	28.767	29.148	28.883
15	8	19	15	14	100	100	100	.062	.103	.086	29.274	29.333	29.434	29.347
16	15	25	23	21	100	100	86	.086	.135	.106	29.520	29.468	29.330	29.439
17	19	31	23	24⅓	84	89	86	.087	.155	.106	29.208	29.152	29.155	29.170
18	18	28	30	25⅓	84	88	100	.082	.135	.167	29.226	29.224	29.235	29.228
19	25	32	29	28⅔	74	100	88	.100	.181	.142	29.135	29.095	29.161	29.130
20	26	37	37	33⅓	100	81	100	.141	.178	.221	29.224	28.886	28.989	29.033
21	35	42	34	37	80	66	79	.162	.177	.155	29.182	29.217	29.217	29.188
22	25	30	30	28⅓	100	100	100	.135	.167	.167	29.270	29.215	29.147	29.211
23	31	43	53	42⅓	100	100	100	.174	.278	.403	29.012	28.664	28.567	28.744
24	53	42	33	42⅓	86	66	70	.348	.177	.131	28.565	28.644	28.839	28.682
25	28	29	28	28⅓	88	100	100	.135	.160	.153	29.035	29.108	29.146	29.096
26	33	38	24	30	100	100	73	.188	.188	.094	29.196	29.246	29.324	29.255
27	25	38	29	30⅔	87	91	88	.117	.208	.142	29.321	29.354	29.388	29.354
28	24	35	24	27⅔	86	80	73	.111	.162	.094	29.497	29.511	29.509	29.506
29	26	43	40	36⅓	87	75	56	.123	.209	.139	29.520	29.400	29.259	29.393
30	47	50	40	45⅔	55	39	56	.179	.139	.139	28.929	29.025	29.144	29.033
31	36	57	60	51	71	52	54	.149	.242	.283	29.038	28.817	28.552	28.801
Sums														
Means				28.16	88.4	83.8	83.7	.144	.181	.121				29.068
Average						85.3			.148					

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MARCH, 1893, AT AGRICULTURAL COLLEGE, MICHIGAN.

Clouds.						Winds.						Registering thermometer.		Rain and snow.			
7 A. M.		2 P. M.		9 P. M.		7 A. M.		2 P. M.		9 P. M.							
Per cent of cloud.	Kind.	Per cent of cloud.	Kind.	Per cent of cloud.	Kind.	Direction.	Force.	Direction.	Force.	Direction.	Force.	Maximum.	Minimum.	Beginning, rain or snow.	Ending, rain or snow.	Inches of rain or melted snow.	Depth of snow, inches.
00	.....	10	Cu.	00	.....	s w	9	s w	16	s w	6	35	10	.....	.....	.....	.....
00	.....	80	Cir. Cu.	100	St.	s w	2	s w	8	s w	9	40	27	In	night	.28	3
10	Cir.	90	Cir. Cu.	90	Cu.	n w	5	n w	11	n w	7	32	6	.....	.....	.....	.....
100	Cu. St.	90	Cu.	00	.....	n w	7	n w	11	n w	4	31	7	.....	.....	.....	.....
70	Cu.	10	Cu.	....	.....	n w	6	n w	12	n w	6	34	6	.....	.....	.....	.....
00	.....	00	.....	90	Cir.	n w	4	w	14	s w	6	35	26	.....	.....	.....	.....
00	.....	.....	.....	00	.....	s w	1	s w	6	s w	1	45	25	.....	.....	.....	.....
100	St.	100	St.	00	.....	s e	3	s e	9	s e	13	45	38	12:30 p.	m.	.....	.....
100	Cu. St.	90	Cu.	00	.....	s	3	s w	5	s w	3	50	35	.....	In night	.35	.....
20	Cu.	10	Cu.	100	St.	s e	4	s e	12	s e	2	47	26	.....	.....	.....	.....
100	St.	100	St.	100	St.	s e	1	s	14	s w	12	52	45	In	night	.12	.....
100	St.	100	St.	90	Cir. St.	s w	10	s w	7	s w	2	37	31	.....	.....	.....	.....
100	St.	100	St.	90	Cu. St.	s e	6	s e	14	e	4	44	31	In	night	.23	.....
100	Cu. St.	100	St.	100	St.	s w	14	s w	12	n w	12	31	7	8:30 a.m.	6 p. m.	.08	2
10	Cu.	100	St.	00	.....	n w	9	n w	11	n w	7	20	5	.....	.....	.....	.....
00	.....	90	Cu.	100	St.	n w	3	w	4	w	3	28	18	.....	.....	.....	.....
10	Cir. St.	5	Cir.	00	.....	s e	1	n e	4	n e	1	37	15	.....	.....	.....	.....
20	Cu.	5	Cu.	....	.....	n e	2	n e	5	n w	4	24	38	.....	.....	.....	.....
100	Cu.	100	Cu.	....	.....	n w	7	n w	7	s w	1	35	25	In	night	.05	¼
100	Cu. St.	100	St.	100	St.	s w	12	s	14	s w	17	43	30	6 p. m.	In night	.16	.....
90	Cu.	100	Cu. St.	100	Cu. St.	w	5	s w	12	s w	2	45	25	In	night	.....	¼
100	St.	100	St.	100	St.	e	4	n e	5	n e	6	30	29	1:20 p	m.	.....	.....
100	St.	100	St.	100	St.	s e	9	s w	6	s w	11	58	42	10 a. m.	4 p. m.	.38	.....
90	Cu.	98	Cu.	100	St.	s w	6	s w	26	s w	16	53	27	In	night	1.10	.....
100	St.	100	St.	50	St.	n	1	n e	5	n w	2	36	20	.....	.....	.....	.....
00	.....	40	Cu.	....	.....	n w	4	n e	4	n w	1	45	22	.....	.....	.....	.....
10	Cir.	00	.....	....	.....	e	3	n e	7	n e	5	41	22	.....	.....	.....	.....
00	.....	.....	.....	....	.....	n e	5	n e	6	n e	2	40	22	.....	.....	.....	.....
00	.....	100	Cir. St.	100	St.	s w	5	s w	15	s w	20	48	49	In	night	.07	.....
98	Cu.	10	Cu.	10	Cir. St.	n w	16	n w	14	n w	2	55	32	.....	.....	.....	.....
10	Cir. St.	100	Cir. St.	90	Cir. St.	w	12	s e	14	s e	13	68	37	.....	.....	.....	.....
....	.....	.....	.....	....	.....	....	....	....	....	....	....	.....	.....	.....	.....	2.82	6
52.8	.....	65.4	.....	51.9	.....	....	....	....	....	....	....	43.8	24.1	.....	.....	.....	.....
		56.7				....	....	....	....	...	....	.....	.....	.....	.....	.....	.....

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METEOROLOGICAL OBSERVATIONS FOR THE MONTH OF

Day of month.	Thermometer, in open air.				Relative humidity, or per cent of saturation.			Pressure of vapor, in inches.			Barometer, reduced to freezing point.			
	7 A. M.	2 P. M.	9 P. M.	Daily mean.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.	Mean.
1	43	50	34	42⅓	75	51	89	.209	.186	.175	28.582	28.724	28.788	28.698
2	47	47	40	44⅓	55	55	82	.179	.179	.203	29.052	29.211	29.122	29.128
3	49	51	53	51	57	100	80	.199	.374	.321	29.007	25.927	28.845	28.926
4	52	55	42	49⅔	86	44	50	.334	.198	.134	28.805	28.884	29.312	28.967
5	35	62	45	47⅓	90	46	84	.183	.256	.251	29.209	29.077	29.281	29.189
6	32	47	49	42⅔	79	55	100	.143	.179	.348	29.388	29.360	29.000	29.249
7	49	58	51	52⅔	100	82	72	.345	.394	.559	28.800	28.618	28.591	28.668
8	55	54	33	47⅓	100	55	100	.433	.231	.188	28.818	28.985	29.145	28.966
9	36	50	44	43⅓	90	58	98	.191	.210	.196	29.224	29.224	29.184	29.211
10	42	50	40	44	74	78	56	.199	.283	.189	29.146	29.180	29.242	29.189
11	38	55	48	47	72	81	78	.165	.349	.260	29.273	29.125	28.982	29.126
12	53	69	50	57⅓	100	52	65	.403	.367	.234	28.682	28.696	28.777	28.715
13	45	47	34	42	61	70	71	.182	.225	.138	28.842	28.944	29.098	28.628
14	32	35	30	32⅓	89	70	100	.152	.142	.167	29.081	29.081	29.031	29.051
15	34	47	30	37	100	49	100	.196	.133	.167	29.044	29.066	29.261	29.180
16	40	55	35	43⅓	100	62	100	.248	.269	.204	29.286	29.108	29.131	29.175
17	38	52	42	44	91	66	88	.208	.257	.222	29.176	29.234	29.316	29.208
18	36	49	44	43	80	71	68	.170	.247	.196	29.196	29.111	29.046	29.118
19	39	46	42	42⅓	91	54	66	.216	.169	.177	29.026	28.950	28.873	28.616
20	37	51	41	43	100	100	65	.221	.374	.169	28.841	28.259	28.361	28.320
21	33	39	35	35⅝	80	73	80	.150	.173	.162	28.416	28.504	28.597	28.506
22	34	42	40	38⅝	100	83	100	.196	.222	.248	28.649	28.761	28.956	28.788
23	40	43	37	40	100	75	81	.248	.209	.178	29.076	29.241	29.241	29.186
24	38	47	39	41⅓	91	62	100	.208	.202	.288	29.234	29.140	29.187	29.187
25	37	45	36	39⅓	90	68	71	.199	.204	.149	29.140	29.209	29.271	29.206
26	39	45	48	44	63	63	100	.152	.204	.335	29.174	29.012	28.745	28.977
27	38	51	43	44	91	59	75	.208	.221	.209	28.816	29.001	29.112	28.976
28	43	55	48	48⅝	83	62	92	.231	.269	.310	29.186	29.128	29.089	29.184
29	35	42	40	39	80	74	100	.162	.199	.248	29.085	29.034	29.066	29.045
30	40	40	37	39	100	100	100	.248	.248	.221	29.076	29.126	29.056	29.086
Sums														29.978
Means				43.5	65.6	69.1	88.8	.220	.228	.228				
Average						74.5			.228					

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APRIL, 1893, AT AGRICULTURAL COLLEGE, MICHIGAN.

Clouds.						Winds.						Registering thermometer.		Rain and snow.			
7 A. M.		2 P. M.		9 P. M.		7 A. M.		2 P. M.		9 P. M.							
Per cent of cloud.	Kind.	Per cent of cloud.	Kind.	Per cent of cloud.	Kind.	Direction.	Force.	Direction.	Force.	Direction.	Force.	Maximum.	Minimum.	Beginning, rain or snow.	Ending, rain or snow.	Inches of rain or melted snow.	Depth of snow, inches.
100	Cu. St.	20	Cu.	00	-------	s w	14	n w	19	n w	4	52	21	-------	-------	------	------
00	-------	100	Cu.	10	Cu.	n w	2	n w	7	s e	7	51	40	-------	-------	------	------
100	Cu. St.	100	Cu. St.	10	Cu.	s w	3	s w	5	s w	7	56	43	8 a. m.	12 m.	.47	------
00	-------	00	-------	00	-------	s w	11	n w	22	n w	3	58	30	-------	-------	------	------
80	Cu.	90	Cir. St.	10	Cu.	w	7	s w	12	n w	8	65	28	-------	-------	------	------
100	Cu. St.	100	Cu. St.	100	Cu.	e	5	s e	13	s e	12	48	35	8 p.m.	In night	1.20	------
100	St.	100	St.	90	Cu. St.	s e	2	s	22	s w	27	76	50	-------	-------	------	------
90	Cir.Cu.	5	Cu.	00	-------	s w	6	s w	19	w	4	54	30	-------	-------	------	------
100	Cu.	5	Cu.	100	St.	n w	2	n	4	e	5	61	42	-------	-------	------	------
100	St.	40	Cu.	00	-------	s w	4	n w	7	e	5	55	35	6:30 a m	12 m.	.05	------
90	Cir. St.	100	St.	100	St.	s w	1	s e	17	s e	19	55	40	2 p. m.	4 p. m.	------	------
100	St.	20	Cu.	100	St.	s e	23	s w	25	s w	12	73	40	In	night	.54	------
00	-------	20	Cu.	00	-------	s w	21	s w	22	w	4	50	31	In	night	.39	------
100	St.	100	St.	100	St.	n e	6	n e	5	e	5	35	23	-------	-------	------	------
100	St.	5	Cu.	00	-------	n w	8	n w	11	n w	6	50	28	-------	-------	------	------
00	-------	95	Cu.	20	Cu.	s w	4	s	14	s w	14	56	34	8:15 a m	8:30 a m	.10	------
00	-------	50	Cu.	10	Cu. St.	w	6	n w	9	s e	4	55	34	-------	-------	------	------
100	St.	100	St.	00	-------	e	4	s e	6	s e	6	50	24	-------	-------	------	------
100	St.	100	St.	100	St.	e	4	e	13	n e	9	48	35	In night	-------	.78	------
100	St.	100	St.	70	Cu. St.	s e	20	s e	15	s	12	52	30	Snowy.	Snowy.	------	------
100	Cu.	100	St.	100	St.	s w	20	s w	23	s w	18	39	32	Snowy.	10 a. m.	.10	------
100	St.	100	Cu. St.	100	Cu.	s w	14	s w	11	n w	9	42	33	-------	-------	------	------
100	St.	100	St.	100	Cu. St.	n w	5	n w	7	n w	5	44	35	-------	-------	------	------
100	Cu. St.	100	Cu. St.	100	St.	----	0	s w	2	n e	3	48	35	5 p. m.	In night	.34	------
100	St.	100	Cu. St.	00	-------	e	1	e	6	n e	4	47	31	-------	-------	------	------
100	St.	100	St.	100	St.	s e	15	s e	15	s e	9	44	37	2:30 p m	-------	------	------
100	St.	80	Cu.	80	Cir. St.	s e	27	s w	24	s w	7	51	35	-------	8 a. m.	.28	------
90	Cu. St.	100	Cir. St.	100	St.	s w	4	w	5	n w	2	57	36	-------	-------	------	------
100	St.	100	St.	80	Cu.	n e	5	n e	7	n e	1	43	25	In	night.	------	------
100	St.	100	St.	100	St.	n e	4	n e	8	e	5	43	56	All	day.	.56	------
----	-------	----	-------	----	-------	----	----	----	----	----	----	-------	-------	-------	-------	4.81	------
85	-------	71	-------	56	-------	----	----	----	----	----	----	51.2	35.1	-------	-------	------	------
70.6%						----	----	----	----	----	----	-------	-------	-------	-------	------	------

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METEOROLOGICAL OBSERVATIONS FOR THE MONTH OF

Day of month.	Thermometer in open air.				Relative humidity or per cent of saturation.			Pressure of vapor, in inches.			Barometer reduced to freezing point.			
	7 A. M.	2 P. M.	9 P. M.	Daily mean.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.	Mean.
1	44	52	49	48⅓	100	100	100	.289	.388	.348	28.903	28.906	28.955	28.921
2	43	52	40	45	100	73	56	.278	.282	.189	29.074	29.036	29.088	29.049
3	43	53	38	46⅓	85	93	72	.285	.375	.165	29.036	29.008	28.998	29.014
4	53	43	39	45⅔	83	43	82	.231	.143	.195	28.986	28.981	28.975	28.981
5	39	41	35	38⅓	100	100	100	.288	.257	.204	28.936	28.900	29.011	28.949
6	40	54	40	44⅔	82	74	100	.203	.308	.248	29.111	29.175	29.349	29.211
7	40	57	65	54	100	58	73	.248	.268	.451	29.349	29.349	29.321	29.339
8	45	63	42	50	61	42	66	.182	.243	.177	29.293	29.231	29.217	29.247
9	58	68	55	60⅓	47	35	68	.229	.261	.295	29.284	29.273	29.296	29.284
10	52	74	58	61⅓	66	56	76	.257	.463	.365	29.331	29.292	29.245	29.249
11	62	79	58	66⅓	77	51	100	.429	.501	.483	29.202	29.065	28.794	29.020
12	54	66	50	43⅓	74	59	93	.308	.376	.335	28.830	28.742	28.699	28.757
13	50	51	50	50⅓	93	93	100	.335	.348	.361	28.674	28.704	28.747	28.708
14	60	63	66	63	100	88	84	.518	.510	.536	28.763	28.783	28.834	28.793
15	50	61	50	53⅔	65	61	65	.284	.325	.234	28.870	28.879	28.902	28.883
16	44	53	50	49	84	78	78	.241	.295	.283	28.904	28.892	28.788	28.861
17	47	60	50	52⅓	77	49	71	.249	.255	.258	28.756	28.784	28.802	28.781
18	45	63	40	49⅓	84	87	73	.251	.216	.182	28.874	28.884	28.885	28.881
19	54	71	60	61⅔	74	41	49	.308	.309	.255	29.038	29.019	28.981	29.013
20	63	83	57	67⅔	62	27	63	.356	.308	.295	28.980	28.932	28.951	28.954
21	62	73	56	63⅔	100	42	75	.556	.345	.336	29.020	29.004	28.937	28.987
22	63	81	73	75⅔	62	52	59	.356	.547	.478	28.866	28.691	28.637	28.731
23	59	47	43	49⅔	100	92	75	.500	.298	.209	28.894	28.658	29.019	28.690
24	51	68	59	59⅓	93	60	76	.348	.411	.380	29.091	29.073	29.089	29.084
25	53	56	46	51⅔	60	63	84	.244	.282	.262	29.093	29.084	29.154	29.110
26	46	50	47	47⅔	69	85	85	.215	.309	.273	29.105	29.090	29.035	29.076
27	48	53	45	48⅔	100	86	76	.335	.348	.228	28.988	29.082	29.004	29.024
28	52	64	47	54⅓	93	48	92	.361	.285	.298	29.018	29.027	29.001	29.015
29	55	75	56	62	81	48	87	.349	.353	.391	28.980	28.858	28.850	28.879
30	55	67	53	58⅓	74	72	73	.321	.399	.295	29.019	28.955	28.995	28.989
31	60	75	58	64⅓	71	56	100	.367	.484	.483	29.076	29.087	29.055	29.053
Sums														
Means				54.4	81.2	63.2	79.0	.310	.335	.304				28.984
Average						74.5			.316					

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MAY, 1893, AT AGRICULTURAL COLLEGE, MICHIGAN.

Clouds.						Winds.						Registering thermometer.		Rain and snow.			
7 A. M.		2 P. M.		9 P. M.		7 A. M.		2 P. M.		9 P. M.							
Per cent of cloud.	Kind.	Per cent of cloud.	Kind.	Per cent of cloud.	Kind.	Direction.	Force.	Direction.	Force.	Direction.	Force.	Maximum.	Minimum.	Beginning, rain or snow.	Ending, rain or snow.	Inches of rain or melted snow.	Depth of snow, inches.
100	St.	100	St.	100	St.	e	1	n e	2	n w	10	52	42	All day.	All day.	.21	.....
100	St.	90	Cu.	5	Cu.	s w	8	s w	12	s w	2	52	37	.....	.....	.....	.....
30	Cu.	100	Cu. St.	10	Cu.	s w	6	s w	6	s w	5	55	35	.....	.....	.....	.....
90	Cu. St.	100	Cu. St.	00	.....	n w	8	n w	8	n w	4	55	34	In night.	.....	.....	.....
100	St.	90	Cu. St.	00	.....	s e	4	n e	6	n e	3	45	33	.....	12.30 pm	.21	.....
90	Cu.	50	Cu.	00	.....	n	3	s w	4	n	1	60	39	.....	.....	.....	.....
00	.....	40	Cu.	20	Cir. Cu.	n e	3	n e	5	n e	1	65	35	.....	.....	.....	.....
00	.....	5	Cu.	00	.....	e	3	e	6	e	1	69	40	.....	.....	.....	.....
00	.....	00	.....	00	.....	e	3	e	5	e	1	74	41	.....	.....	.....	.....
00	.....	90	Cu.	20	Cu.	s e	2	s w	5	s w	3	77	55	.....	.....	.....	.....
100	Cu. St.	100	Cu. St.	100	Nim.	s w	6	s w	16	s w	9	80	54	5.30 p m	In night.	.....	.....
50	Cir. Cu.	20	Cu.	100	Nim.	s w	13	s w	18	s e	6	70	48	In night.	In night.	.27	.....
100	Cu. St.	100	St.	100	Cu.	s w	7	s w	6	n w	5	51	63	.....	.....	.....	.....
100	Cu.	90	Cu.	100	Cu. St.	n w	9	n w	8	s w	3	63	45	.....	.....	.....	.....
90	Cu.	00	.....	100	St.	n w	2	n e	4	n e	4	66	43	.....	.....	.....	.....
100	St.	90	Cu.	50	Cir. St.	n w	7	n w	6	n w	11	53	47	.....	.....	.....	.....
20	Cu.	20	Cu.	00	.....	n w	9	n w	12	n w	5	65	39	.....	.....	.....	.....
00	.....	00	.....	00	.....	n w	6	n e	8	n w	1	69	37	.....	.....	.....	.....
00	.....	00	.....	00	.....	s w	5	s e	5	s e	4	75	57	.....	.....	.....	.....
00	.....	10	Cu.	10	Cu.	s w	8	s w	15	s w	4	83	49	.....	.....	.....	.....
00	.....	40	St.	00	.....	s w	8	s w	12	n w	5	73	45	.....	.....	.....	.....
85	St.	90	Cir. St	80	St.	s e	7	s e	17	s e	10	83	60	4 a. m.	10 a. m.	.96	.....
100	St.	100	Cu. St.	00	.....	n w	9	n w	13	n w	8	60	38	.....	.....	.....	.....
00	.....	60	Cu.	60	Cu. St.	s w	6	s w	14	s w	12	70	52	.....	.....	.....	.....
100	Cu. St.	90	Cu.	80	Cir. Cu.	n w	9	n w	3	e	4	62	43	.....	.....	.....	.....
100	St.	100	St.	100	Cu. St.	e	4	n e	7	n e	1	50	44	.....	.....	.....	.....
100	St.	100	St.	00	.....	s e	1	s w	8	s w	1	53	63	.....	.....	.....	.....
00	.....	00	.....	00	.....	s w	3	s w	2	s w	1	70	44	.....	.....	.....	.....
10	Cu. St.	90	Cu.	90	Cu.	s w	2	s w	3	s w	1	75	46	.....	.....	.....	.....
90	Cir.	00	.....	00	.....	s w	3	s w	3	.....	0	75	50	.....	.....	.....	.....
90	Cu. St.	20	Cu.	80	Cu.	e	5	s e	12	s e	2	75	55	In night.	In night.	.25	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2.86	.....
58.8	.....	57.5	.....	38.5	.....	.....	.....	.....	.....	.....	.....	64.3	45.5	.....	.....	.....	.....
				51.6		.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

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METEOROLOGICAL OBSERVATIONS FOR THE MONTH OF

Day of month.	Thermometer in open air.				Relative humidity, or per cent of saturation.			Pressure of vapor in inches.			Barometer reduced to freezing point.			
	7 A. M.	2 P. M.	9 P. M.	Daily Mean.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.	Mean.
1	59	67	62	62⅔	100	79	88	.500	.522	.491	29.033	28.879	28.848	28.920
2	67	74	62	67⅔	89	77	88	.591	.641	.491	28.899	28.948	29.084	29.293
3	63	71	70	68	100	100	95	.576	.759	.695	29.069	29.088	29.006	29.037
4	69	82	69	73⅓	100	71	85	.708	.773	.599	29.028	28.964	28.969	28.987
5	68	78	68	68	90	73	77	.612	.628	.446	28.976	28.956	28.977	28.971
6	58	68	56	60⅔	88	60	69	.423	.411	.308	29.030	29.117	29.199	29.115
7	57	73	59	63	81	50	88	.378	.409	.439	29.332	29.309	29.303	29.315
8	63	76	62	67	72	49	83	.416	.436	.460	29.325	29.201	29.150	29.225
9	65	81	69	71⅔	88	52	75	.456	.547	.529	29.117	29.009	29.097	29.074
10	60	75	54	63	88	68	100	.456	.591	.418	29.097	29.115	29.072	29.095
11	64	66	58	62⅔	89	84	82	.529	.586	.394	29.157	29.220	29.243	29.206
12	59	75	62	65⅓	82	52	77	.410	.449	.429	29.268	29.254	29.243	29.253
13	62	77	58	65⅔	88	57	82	.491	.527	.394	29.183	29.178	29.166	29.176
14	66	76	66	69⅓	78	64	84	.502	.577	.536	29.169	29.140	29.075	29.128
15	68	81	64	71	85	59	83	.577	.624	.497	29.094	29.027	29.026	29.049
16	71	82	63	72	80	71	100	.608	.773	.576	29.081	28.875	29.021	28.976
17	67	79	64	70	91	62	100	.626	.612	.596	29.057	29.112	29.107	29.092
18	70	83	67	73⅓	80	56	95	.586	.637	.626	29.219	29.214	29.217	29.217
19	73	87	67	75⅔	72	55	84	.581	.705	.556	29.288	29.251	29.210	29.249
20	73	75	68	72	85	90	100	.693	.785	.685	29.178	29.086	28.992	29.095
21	70	83	71	74⅔	90	72	95	.658	.802	.720	28.927	28.864	28.814	28.868
22	68	71	56	71⅔	79	54	69	.543	.408	.308	28.766	28.857	28.988	28.854
23	64	77	60	67	77	49	94	.429	.557	.487	29.075	29.138	29.126	29.113
24	64	81	63	69⅓	89	56	77	.529	.585	.446	29.162	29.092	29.006	29.086
25	66	77	63	68⅔	89	46	83	.570	.422	.478	28.880	28.872	28.883	28.878
26	65	78	58	70⅓	73	36	88	.451	.242	.456	28.962	28.960	28.978	28.961
27	63	76	60	66⅓	77	49	88	.446	.436	.456	29.017	29.087	29.091	29.048
28	63	75	61	66⅓	83	64	88	.478	.554	.473	29.147	29.143	29.161	29.150
29	65	79	65	69⅔	89	58	89	.549	.574	.549	29.238	29.192	29.175	29.201
30	68	84	67	73	75	47	64	.509	.545	.425	29.179	29.140	29.125	29.148
Sums														
Means				66.6	84.8	62	86	.529	.568	.498				28.767
Average						77.6			.532					

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JUNE, 1893, AT AGRICULTURAL COLLEGE, MICHIGAN.

Clouds.						Winds.						Registering thermometer.		Rain and snow.			
7 A. M.		2 P. M.		9 P. M.		7 A. M.		2 P. M.		9 P. M.							
Per cent of cloud.	Kind.	Per cent of cloud.	Kind.	Per cent of cloud.	Kind.	Direction.	Force.	Direction.	Force.	Direction.	Force.	Maximum.	Minimum.	Beginning, rain or snow.	Ending, rain or snow.	Inches of rain or melted snow.	Depth of snow, inches.
100	St.	100	St.	80	Cu.	s e	7	s e	15	s w	7	71	58	2 p. m.	.....	.97	.....
90	Cu.	90	Cu.	100	Cu.	s w	5	s w	10	s w	2	74	62	.....	.....	.....	.....
100	Cu.	100	St.	100	St.	s w	2	s w	3	s w	7	76	62	.....	8 p. m.	1.01	.....
100	Cu.	70	Cu.	100	Cu. St.	w	10	s w	9	s w	5	83	65	.....	.....	.....	.....
100	Cu. St.	100	Nim.	50	St.	s w	8	s w	8	s w	2	75	55	11 a. m.	1 p. m.	.05	.....
10	St.	50	Cu.	00	.....	n w	6	w	9	w	11	72	49	.....	.....	.....	.....
00	.....	20	Cu.	00	.....	w	7	w	8	w	1	76	52	.....	.....	.....	.....
00	.....	40	Cu. St.	10	Cir.	s w	7	s	10	s w	6	78	59	.....	.....	.....	.....
20	Cu.	20	Cu.	30	St.	s w	8	s w	3	s w	5	81	60	In night.	.....	.07	.....
100	St.	100	Cu. St.	100	Nim.	n	1	n	2	n e	5	75	57	4 p. m.	In night.	1.50	.....
90	Cu.	90	Cu.	00	.....	n e	3	e	2	n e	1	71	51	.....	.....	.....	.....
00	.....	00	.....	00	.....	n e	3	s e	6	s e	1	80	52	.....	.....	.....	.....
00	.....	10	Cu.	00	.....	s e	1	s e	4	e	1	80	54	.....	.....	.....	.....
00	.....	50	Cu.	10	Cir.	s e	1	s e	3	s e	1	82	58	.....	.....	.....	.....
00	.....	90	Cir. St.	20	St.	n e	3	e	4	....	0	84	60	2:30 p m	3:30 p m	.04	.....
20	Cir. St.	90	Cu.	40	Cu. St.	s e	1	s e	3	n e	1	87	63	2 p. m.	6 p. m.	.83	.....
....	....	10	Cu.	....	.....	n e	1	n e	3	....	0	85	58	6:30 p m	.....	.05	.....
....	.....	...	.....	....	.....	s e	1	s e	2	s e	1	87	60	.....	.....	.....	.....
00	.....	00	.....	....	.....	s e	1	s e	4	s e	2	90	63	.....	.....	.....	.....
00	.....	100	Cu. St.	100	Cu. St.	s e	4	s e	7	s w	3	90	68	12.30 pm	6 p. m.	.64	.....
100	Cu. St.	90	Cu.	80	Cu.	w	4	n w	8	w	6	83	67	7:30 a m	9 a. m.	.18	.....
100	Cu. St.	20	Cu.	....	.....	n w	8	w	11	w	1	74	52	.....	.....	.....	.....
00	.....	20	Cu.	....	.....	w	3	w	5	....	....	80	54	.....	.....	.....	.....
00	.....	30	Cu.	100	Cu. St.	w	1	w	11	w	7	81	64	.....	.....	.....	.....
15	Cu.	5	Cu.	20	Cu.	w	12	w	13	w	4	78	55	5 p. m.	6 p. m.	.06	.....
00	.....	50	Cu.	00	.....	n w	4	n w	8	n w	1	81	56	.....	.....	.....	.....
50	Cu.	10	Cu.	00	.....	s e	2	s e	4	n e	1	80	58	.....	.....	.....	.....
10	Cu.	15	Cu.	..	.....	n e	1	s e	1	s e	1	80	55	.....	.....	.....	.....
10	Cu.	10	Cu.	00	.....	....	0	n e	4	....	....	82	55	.....	.....	.....	.....
50	Cu.	10	Cir. Cu.	90	Cu.	s e	4	s e	6	s e	2	84	65	.....	.....	.....	.....
....	.....	....	.....	....	.....	....	....	....	....	....	....	.....	.....	.....	.....	4.85	.....
32	.....	43	.....	34	.....	....	....	....	....	....	....	80	58.1	.....	.....	.....	.....
39.6%						....	....	....	....	....	....	.....	.....	.....	.....	.....	.....

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METEOROLOGICAL OBSERVATIONS FOR THE MONTH OF

Day of month.	Thermometer in open air.				Relative humidity or per cent of saturation.			Pressure of vapor, in inches.			Barometer reduced to freezing point.			
	7 A. M.	2 P. M.	9 P. M.	Daily mean.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.	Mean.
1	65	77	64	68⅝	89	77	89	.549	.717	.529	29.111	29.067	29.081	29.086
2	73	86	68	75⅝	77	47	69	.617	.596	.476	29.067	29.033	28.991	29.030
3	64	74	64	67⅝	73	48	77	.433	.396	.464	29.059	29.083	29.105	29.082
4	53	74	65	64	93	56	78	.375	.463	.433	29.166	29.184	28.991	29.113
5	69	75	55	66⅛	85	73	100	.599	.628	.433	28.844	28.940	29.082	28.955
6	58	62	65	62	100	94	89	.483	.543	.549	29.153	29.085	29.095	29.111
7	63	86	74	74½	100	80	90	.576	.989	.758	29.105	29.060	28.986	29.050
8	76	78	58	70⅝	73	78	94	.652	.744	.452	28.952	28.972	29.086	29.008
9	66	72	60	66	59	54	94	.376	.422	.487	29.199	29.186	29.133	29.174
10	66	76	58	66⅝	78	56	88	.502	.505	.423	29.245	29.256	29.226	29.242
11	64	83	62	69⅝	77	53	94	.464	.597	.523	29.266	29.207	29.146	29.206
12	73	89	68	76⅝	67	53	90	.545	.721	.612	29.168	29.136	29.099	29.134
13	77	92	73	80⅝	82	57	85	.758	.860	.698	29.075	28.989	29.004	29.023
14	75	86	80	80⅛	90	76	96	.785	.942	.977	29.015	29.041	29.041	29.032
15	76	86	69	77	81	68	95	.781	.850	.671	28.872	28.893	28.914	28.893
16	75	87	73	78⅛	86	55	95	.745	.705	.771	28.967	28.948	28.923	28.946
17	70	81	67	72⅝	85	62	85	.621	.664	.556	28.931	28.969	29.037	28.979
18	63	77	62	67⅛	88	69	100	.510	.639	.556	29.132	29.147	29.171	29.150
19	64	79	63	68⅝	100	54	88	.596	.537	.510	29.260	29.272	29.281	29.271
20	65	79	59	67⅝	89	54	94	.549	.537	.469	29.318	29.302	29.221	29.280
21	75	83	70	76	60	50	66	.519	.558	.482	29.209	29.171	29.112	29.184
22	70	86	62	72⅝	70	54	66	.516	.677	.370	29.044	29.039	29.010	29.031
23	63	77	60	66⅝	72	46	82	.416	.422	.426	29.089	29.063	29.115	29.077
24	60	80	71	70⅛	88	62	80	.556	.638	.608	29.230	29.156	29.127	29.171
25	75	90	72	79	77	53	86	.666	.751	.668	29.120	29.036	28.905	29.020
26	77	83	62	74	82	43	72	.758	.483	.399	28.977	29.001	29.181	29.153
27	57	77	61	65	75	53	77	.350	.492	.418	29.302	29.245	29.195	29.247
28	72	85	71	76	66	54	90	.524	.650	.682	29.147	29.049	29.015	29.070
29	69	81	73	74½	79	56	77	.564	.585	.617	29.131	29.139	29.130	29.133
30	67	85	64	72	89	54	83	.591	.650	.497	29.137	29.142	29.005	29.095
31	72	81	59	70⅝	72	59	76	.559	.624	.380	28.961	28.864	29.077	28.967
Sums														
Means				71.5	80.7	59.5	85.3	.564	.634	.514				29.069
Average						75.1			.571					

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JULY, 1898, AT AGRICULTURAL COLLEGE, MICHIGAN.

Clouds.						Winds.						Registering thermometer.		Rain and snow.			
7 A. M.		2 P. M.		9 P. M.		7 A. M.		2 P. M.		9 P. M.							
Per cent of cloud.	Kind.	Per cent of cloud.	Kind.	Per cent of cloud.	Kind.	Direction.	Force.	Direction.	Force.	Direction.	Force.	Maximum.	Minimum.	Beginning, rain or snow.	Ending, rain or snow.	Inches of rain or melted snow.	Depth of snow, inches.
100	Cu. St.	100	St.	00	.....	s e	2	s e	2	s e	1	85	55	1.30 p m	3.30 p m	.11	.....
100	Cir.	30	Cu.	90	Cu.	s e	1	s w	1	....	0	86	56	In night.	In night.	.08	.....
00	.....	3	Cu.	00	.....	s w	1	s w	6	....	0	74	46	.....	.....	.....	.....
00	.....	100	St.	100	St.	....	0	s w	6	s w	7	74	46	4 p. m.	6 p. m.	.04	.....
100	St.	90	Cu.	00	.....	s w	5	s w	10	....	0	75	53	In night.	.....	.....	.....
100	St.	100	St.	100	St.	s w	3	s w	7	s w	2	65	57	.....	10.30 am	.43	.....
100	St.	90	Cu.	10	Cu.	s w	3	s w	8	s w	6	89	73	.....	.....	.....	.....
100	Cir. St.	90	Cu. St.	00	.....	s w	10	s w	8	s w	1	81	57	.....	.....	.....	.....
70	Cu.	30	Cu.	15	Cu.	n e	2	n e	3	n e	1	79	52	.....	.....	.....	.....
20	Cu.	90	Cu.	80	Cir. Cu.	e	1	s e	1	s e	1	79	52	.....	.....	.....	.....
20	Cir. Cu	80	Cir. Cu.	10	Cu.	n e	2	n e	8	s w	2	83	62	.....	.....	.....	.....
00	.....	60	Cu.	10	Cu.	s e	4	s e	8	s e	2	90	69	.....	.....	.....	.....
00	.....	90	Cir. Cu.	100	Cu. St.	s w	6	w	12	w	1	92	69	.....	.....	.....	.....
100	Cu. St.	100	Cu. St.	20	Cu.	w	2	w	2	s w	1	86	67	9 a. m.	11 a. m.	.01	.....
30	Cu.	100	Cu. St.	00	.....	s w	3	s w	9	w	1	86	65	1 p. m.	2 p. m.	.10	.....
00	.....	100	Nim.	00	.....	s w	3	s w	6	w	2	87	60	1.30 a.m	3.30 p.m	.35	.....
00	.....	90	Cu.	90	Cu. St.	s w	4	n w	6	w	2	82	56	In night.	In night.	.03	.....
00	.....	50	Cu.	00	.....	n w	1	n w	2	....	0	80	56	.....	.....	.....	.....
00	.....	20	Cu.	00	.....	....	0	n w	2	....	0	84	55	.....	.....	.....	.....
00	.....	00	.....	00	.....	....	0	n w	3	....	0	83	56	.....	.....	.....	.....
00	.....	10	Cu.	00	.....	....	0	n w	4	n w	2	89	59	.....	.....	.....	.....
20	Cir. Cu.	20	Cu.	30	Cu	w	4	w	9	w	1	89	50	.....	.....	.....	.....
100	.....	5	St.	5	Cir.	n e	3	n e	3	n e	3	82	57	.....	.....	.....	.....
100	St.	5	Cu.	00	.....	n e	1	n e	7	n e	1	89	58	6 a. m.	8 a. m.	.05	.....
00	.....	00	.....	70	Cu.	s w	5	s w	1	s w	1	91	67	3 p. m.	6 p. m.	.06	.....
80	Cu.	10	Cu.	00	.....	s w	1	s w	10	n w	1	86	47	.....	.....	.....	.....
00	.....	10	Cir. St.	00	.....	n w	2	s w	3	n e	3	82	55	.....	.....	.....	.....
90	Cu. St.	100	Cir. St.	80	Cu.	s	2	s	10	s w	1	85	64	.....	.....	.....	.....
00	.....	10	Cu.	00	.....	s w	1	n w	4	....	0	88	54	.....	.....	.....	.....
00	.....	00	.....	90	Cu.	s e	1	s e	4	....	0	89	60	.....	.....	.....	.....
00	.....	90	Cu.	00	.....	s w	1	s w	4	....	0	85	50	.....	.....	.....	.....
																1.86	.....
36.4	.....	50.8	.....	28.8	.....	....	....	....	....	....	....	83.4	57.5	.....	.....	.....	.....
				38.6		....	....	....	....	....	....	.....	.....	.....	.....	.....	.....

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METEOROLOGICAL OBSERVATIONS FOR THE MONTH OF

Day of month.	Thermometer, in open air.				Relative humidity or per cent of saturation.			Pressure of vapor, in inches.			Barometer reduced to freezing point.			
	7 A. M.	2 P. M.	9 P. M.	Daily mean.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.	Mean.
1	59	76	58	64⅓	88	56	82	.489	.505	.394	29.140	29.099	29.164	29.134
2	60	80	60	66⅔	88	51	88	.456	.523	.456	29.249	29.124	29.121	29.165
3	67	86	64	72⅓	75	51	73	.489	.637	.433	29.240	29.158	29.107	29.168
4	67	87	63	72⅓	75	52	88	.489	.758	.510	29.089	29.025	28.977	29.030
5	76	90	68	78	68	53	85	.614	.751	.577	29.000	28.960	29.110	29.033
6	60	70	65	65	71	57	89	.367	.416	.549	29.208	29.107	29.153	29.156
7	54	74	64	64	87	51	89	.362	.429	.529	29.196	29.176	29.176	29.182
8	65	84	64	71	73	47	89	.451	.545	.529	29.184	29.162	29.173	29.173
9	68	88	64	73⅓	69	46	73	.476	.609	.483	29.168	29.148	29.107	29.141
10	78	91	74	81	62	51	73	.588	.737	.604	29.084	29.046	28.997	29.042
11	76	84	67	75⅔	81	72	75	.731	.882	.489	28.967	28.961	29.010	28.979
12	61	78	63	65⅔	83	68	77	.442	.510	.446	29.135	29.148	29.223	29.169
13	61	78	52	63⅔	88	54	73	.473	.514	.282	29.312	29.259	29.218	29.263
14	61	77	55	64⅓	88	57	74	.473	.527	.321	29.242	29.148	29.137	29.176
15	61	81	65	69	88	62	73	.473	.664	.451	29.159	29.076	29.056	29.097
16	69	68	67	68	79	95	95	.564	.648	.626	29.027	28.974	28.944	28.981
17	64	77	62	67⅔	94	73	94	.563	.678	.523	29.019	29.030	29.038	29.089
18	63	71	67	67	100	86	79	.576	.644	.522	29.065	28.998	29.006	29.019
19	56	67	62	61⅔	87	95	83	.391	.626	.460	29.060	29.079	29.097	29.079
20	60	71	53	61⅓	100	76	98	.518	.572	.375	29.188	29 165	29.180	29.177
21	57	74	60	63⅔	100	67	88	.466	.568	.456	29.212	29.169	29.144	29.175
22	62	79	69	70	88	69	95	.491	.691	.671	29.170	29.156	29.143	29.156
23	62	85	70	72⅓	100	41	66	.556	.498	.482	29.152	29.067	29.045	29.088
24	71	84	67	74	80	60	100	.608	.704	.662	29.051	29.005	28.996	29.017
25	67	80	67	71⅓	89	78	89	.591	.800	.591	29.028	29.065	29.070	29.054
26	62	81	70	71	100	79	90	.556	.829	.658	29.228	29.133	29.178	29.179
27	66	84	71	73⅔	94	83	90	.604	.969	.682	29.430	29.559	29.033	29.341
28	64	76	65	68⅓	77	81	73	.464	.731	.451	29.043	29.037	29.061	29.047
29	58	68	55	60⅓	88	79	74	.423	.543	.321	29.099	28.997	29.096	29.064
30	45	72	50	55⅔	92	66	85	.275	.524	.309	29.185	29.177	29.163	29.175
31	47	75	53	58⅓	92	68	86	.298	.591	.348	29.212	29.198	29.110	29.173
Sums														
Means				68.1	84	66	83	.492	.631	.488				29.119
Average						77.6			.537					

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AUGUST 1893, AT AGRICULTURAL COLLEGE, MICHIGAN.

Clouds.						Wind.						Registering thermometer.		Rain and snow.			
7 A. M.		2 P. M.		9 P. M.		7 A. M.		2 P. M.		9 P. M.							
Per cent of cloud.	Kind.	Per cent of cloud.	Kind.	Per cent of cloud.	Kind.	Direction.	Force.	Direction.	Force.	Direction.	Force.	Maximum.	Minimum.	Beginning, rain or snow.	Ending, rain or snow.	Inches of rain or melted snow.	Depth of snow, inches.
00	.....	80	Cu.	....	.....	....	0	n e	2	....	0	83	46	.....	.....	.....	.....
....	.....	60	Cu.	....	.....	n e	2	n e	4	....	0	87	54	.....	.....	.....	.....
....	.....	10	Cu.	....	.....	....	0	w	5	w	2	89	55	.....	.....	.....	.....
20	Cu.	10	Cu.	....	.....	s	6	s	9	s	3	91	63	.....	.....	.....	.....
5	Cu.	95	Cu.	100	Cu.	s w	5	w	5	....	0	91	56	.....	.....	.....	.....
10	Cu.	....	.....	100	Cu.	....	0	n e	3	....	0	82	41	.....	.....	.....	.....
....	.....	....	.....	....	.....	....	0	n e	3	....	0	81	45	.....	.....	.....	.....
....	.....	....	.....	....	.....	s w	4	s w	6	....	0	87	52	.....	.....	.....	.....
....	.....	....	.....	....	.....	s w	3	s w	9	s w	5	93	57	.....	.....	.....	.....
....	.....	....	.....	....	.....	s w	2	s w	12	s w	2	95	67	.....	.....	.....	.....
60	Cu.	100	Cu. St.	....	.....	s w	3	s w	3	....	0	82	52	.....	.....	.....	.....
....	.....	20	Cu.	20	Cu.	n	1	n e	5	....	0	78	58	.....	.....	.....	.....
....	.....	50	St.	....	.....	e	1	s e	3	s e	5	78	48	.....	.....	.....	.....
....	.....	....	.....	....	.....	e	3	e	1	e	3	82	47	.....	.....	.....	.....
10	Cu.	40	Cu.	....	.....	....	0	....	0	....	0	87	58	.....	.....	.....	.....
100	Nim.	100	Nim.	100	Nim.	w	2	....	0	....	0	69	60	7 A. M.	.....	.26	.....
95	St.	60	Cu. St.	75	Cu. St.	n w	2	n w	4	....	0	81	56	.....	.....	.....	.....
15	Cu.	40	Cu.	95	Cu.	n w	2	....	0	n w	1	79	50	11 A. M.	12 A. M.	.18	.....
....	.....	90	Cu. St.	75	Cu. St.	n w	1	....	0	....	0	73	56	.....	.....	.....	.....
100	Cu.	50	Cu.	....	.....	....	0	....	0	....	0	77	46	.....	.....	.....	.....
....	.....	30	Cu.	10	Cu. St.	....	0	s e	2	s e	3	80	54	.....	.....	.....	.....
50	Cu.	50	Cu.	....	.....	s e	7	s	1	w	1	86	57	.....	.....	.....	.....
....	.....	....	.....	20	Cu. St.	s e	4	s	9	s	2	90	58	.....	.....	.....	.....
50	Cu.	25	Cu.	100	Cu.	s	2	s	1	w	1	90	61	6:30 p.m.	Night	.15	.....
75	Cu.	90	Cu.	15	Cir.	s w	1	s w	4	s w	5	80	52	.....	.....	.....	.....
....	.....	95	Cu.	00	.....	n w	8	n w	8	n w	5	81	55	.....	.....	.....	.....
10	Cu.	20	Cu.	40	Cu.	n w	7	w	4	s w	6	87	58	In night		.02	.....
80	Cu. St.	80	Cu.	60	Cir. St.	s e	4	s e	6	n e	1	77	54	.....	.....	.....	.....
100	Cu. St.	80	Cu.	00	.....	n e	1	n e	4	n w	1	71	38	.....	.....	.....	.....
00	.....	00	.....	00	.....	....	0	n w	4	....	0	79	42	.....	.....	.....	.....
00	.....	00	.....	00	.....	....	0	n e	3	....	0	80	45	.....	.....	.....	.....
....	.....	....	.....	....	.....	....	....	....	....	....	....			.....	.....	.56	.....
25	.....	41	.....	27	.....	....	....	....	....	....	....	82.7	52.9	.....	.....	.....	.....
				31⅝		....	....	....	....	....	....	.....	.....	.....	.....	.....	.....

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METEOROLOGICAL OBSERVATIONS FOR THE MONTH OF

Day of month.	Thermometer, in open air.				Relative humidity, or per cent of saturation.			Pressure of vapor, in inches.			Barometer, reduced to freezing point.			
	7 A. M.	2 P. M.	9 P. M.	Daily mean.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.	Mean.
1	58	78	49	60	93	73	78	.375	.704	.272	28.984	28.850	29.004	28.946
2	43	67	44	51½	100	64	84	.278	.425	.241	29.111	29.106	29.094	29.104
3	50	75	52	59	78	68	79	.288	.591	.306	29.071	28.946	28.949	28.988
4	59	84	63	68⅝	82	95	83	.410	.854	.478	28.919	28.886	28.883	28.896
5	55	81	64	66⅝	100	79	83	.433	.829	.497	28.890	28.887	28.941	28.906
6	57	79	65	67	100	74	84	.466	.781	.516	29.009	28.991	28.891	28.963
7	70	82	61	71	80	75	88	.586	.816	.473	28.791	28.864	29.024	28.893
8	49	70	47	55½	100	80	92	.348	.586	.298	29.089	29.094	29.101	29.088
9	49	74	53	58⅔	100	81	86	.348	.680	.348	29.077	29.021	28.975	29.024
10	55	83	61	66⅓	87	75	88	.391	.816	.473	28.996	28.996	29.027	28.996
11	56	80	66	67⅓	94	74	84	.420	.758	.536	29.056	29.050	29.026	29.044
12	64	72	69	68⅓	94	95	96	.563	.745	.671	29.022	29.011	28.988	29.007
13	67	70	69	68⅝	96	100	100	.626	.733	.708	28.964	28.941	28.886	28.930
14	68	79	72	73	100	95	90	.685	.945	.706	28.838	28.777	28.726	28.780
15	56	79	57	64	100	69	100	.449	.691	.466	28.889	28.890	28.814	28.864
16	51	61	44	52	86	88	76	.321	.442	.218	28.897	28.948	29.002	28.947
17	47	64	56	55⅝	100	83	75	.323	.497	.336	29.115	28.945	28.982	29.014
18	58	78	69	68⅓	94	86	85	.452	.527	.599	28.820	28.771	28.764	28.785
19	64	78	52	64⅔	94	86	93	.563	.527	.361	28.837	28.882	29.063	28.931
20	49	67	48	54⅝	100	84	92	.348	.556	.310	29.161	29.160	29.065	29.128
21	58	76	78	70⅝	88	86	73	.423	.772	.704	28.999	28.878	28.737	28.871
22	65	68	52	61⅝	94	85	98	.583	.577	.361	28.826	28.946	28.980	28.911
23	51	68	40	53	98	85	82	.348	.577	.303	28.909	28.889	28.980	28.926
24	45	54	51	50	92	93	98	.275	.390	.348	29.041	28.983	28.847	28.956
25	46	51	33	43	84	86	89	.251	.321	.168	28.881	29.020	29.162	29.021
26	38	58	37	44⅓	91	88	81	.206	.423	.178	29.230	29.191	29.240	29.220
27	34	62	40	45½	100	83	82	.196	.460	.203	29.230	29.226	29.202	29.219
28	33	52	33	39⅔	89	96	89	.168	.334	.168	29.298	29.276	29.332	29.268
29	30	58	50	46	100	82	85	.167	.394	.309	29.291	29.253	29.190	29.225
30	46	51	49	48⅝	100	100	92	.311	.374	.322	29.060	28.919	28.998	28.959
Sums														
Means				58.41	93.6	83.1	86.5	.336	.620	.334				28.998
Average						87.7			.463					

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SEPTEMBER, 1893, AT AGRICULTURAL COLLEGE, MICHIGAN.

Clouds.						Winds.						Registering thermometer.		Rain and snow.			
7 A. M.		2 P. M.		9 P. M.		7 A. M.		2 P. M.		9 P. M.							
Per cent of cloud.	Kind.	Per cent of cloud.	Kind.	Per cent of cloud.	Kind.	Direction.	Force.	Direction.	Force.	Direction.	Force.	Maximum.	Minimum.	Beginning, rain or snow.	Ending, rain or snow.	Inches of rain or melted snow.	Depth of snow, inches.
00	.....	50	Cu.	00	.....	....	0	w	18	n w	1	81	38	4 p. m.	5 p. m.	.07	.....
00	.....	80	Cu.	00	.....	....	0	n w	5	....	0	70	38	.....	.....	.....	.....
00	.....	00	.....	40	Cir.	w	1	w	11	....	0	76	50	.....	.....	.....	.....
00	.....	00	.....	00	.....	s w	3	s w	9	....	0	84	50	.....	.....	.....	.....
00	.....	00	.....	00	.....	....	0	w	4	s w	1	82	47	.....	.....	.....	.....
00	.....	00	.....	00	.....	s e	2	s e	6	s e	4	82	57	.....	.....	.....	.....
90	Cu. St.	00	.....	00	.....	s w	6	s w	5	n w	1	83	43	.....	.....	.....	.....
00	.....	00	.....	00	.....	n e	1	e	4	n e	1	72	43	.....	.....	.....	.....
20	Cu. St.	60	Cir.	5	Cir.	n e	1	s e	3	....	0	74	43	.....	.....	.....	.....
10	Cu. St.	50	Cir. St.	00	.....	....	0	n e	3	n e	1	83	44	.....	.....	.....	.....
2	St.	10	Cir.	00	.....	e	2	s e	5	e	1	83	56	.....	.....	.....	.....
80	Cir. St.	100	St.	100	St.	s e	4	e	7	n e	6	73	63	5 p. m.	.....	.....	.....
100	St.	100	St.	2	Cu.	s e	2	w	3	w	3	73	64	.....	5:30 p m	.26	.....
00	.....	100	Cu. St.	00	.....	s e	4	s e	10	....	0	83	55	.....	.....	.....	.....
100	Fog.	00	.....	100	Cu. St	w	3	n w	8	n w	6	79	49	6 p. m.	8 p. m.	.19	.....
00	.....	100	Cu. St.	00	.....	w	7	w	12	w	5	68	35	.....	.....	.....	.....
00	.....	00	.....	5	St.	w	7	w	5	s w	4	64	47	In night	.....	.....	.....
100	St.	90	Cu. St.	100	Cu. St.	s w	3	s e	1	....	0	79	61	.....	9 p. m.	.05	.....
00	.....	100	Cu. St.	00	.....	....	0	n w	9	....	0	82	45	In night	.....	.22	.....
85	Cu. St.	100	Cu. St.	00	.....	....	0	w	1	w	6	70	49	.....	.....	.....	.....
90	Cu. St.	40	Cir. Cu.	100	Cu. St.	s e	3	s e	10	s e	12	80	64	In	night	.32	.....
100	Cu. St.	00	.....	100	St.	n w	5	n w	6	....	0	72	48	.....	.....	.....	.....
5	Cu.	80	Cu.	00	.....	n w	2	n w	10	w	3	71	32	2:30 p m	7 p. m.	.06	.....
50	Cu.	100	St.	90	St.	w	5	w	6	w	3	62	43	.....	.....	.....	.....
00	.....	90	Cu. St.	00	.....	n w	3	n w	8	w	3	54	27	.....	.....	.....	.....
5	Cir. St.	80	Cu. St.	00	.....	w	4	w	8	....	0	62	27	.....	.....	.....	.....
00	.....	20	Cu.	00	.....	w	1	n w	7	n w	5	68	27	.....	.....	.....	.....
00	.....	00	.....	00	.....	n w	3	n w	5	....	0	56	32	.....	.....	.....	.....
00	.....	100	Cir. St.	100	Cu. St.	n w	1	n w	3	s e	10	60	40	In night	.....	.....	.....
100	St.	100	St.	100	St.	s e	6	w	6	s e	4	66	44	.....	7:30 p m	.67	.....
----	.....	----	.....	----	.....	....	....	....	....	....	....	.....	.....	.....	.....	1.84	.....
31.2	.....	50.0	.....	44.0	.....	....	....	....	....	....	....	74.1	45.0	.....	.....	.....	.....
41.7						....	....	....	....	....	....	.....	.....	.....	.....	.....	.....

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METEOROLOGICAL OBSERVATIONS FOR THE MONTH OF

Day of month.	Thermometer in open air.				Relative humidity or per cent of saturation.			Pressure of vapor, in inches.			Barometer reduced to freezing point.			
	7 A. M.	2 P. M.	9 P. M.	Daily mean.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.	Mean.
1	59	69	51	59⅗	82	79	86	.410	.564	.321	28.949	28.916	28.929	28.931
2	53	73	61	62⅕	93	85	83	.375	.693	.442	28.924	28.864	28.809	28.865
3	60	56	50	55⅕	100	100	100	.518	.449	.361	28.825	28.816	28.753	28.798
4	44	64	53	53⅔	84	67	80	.241	.403	.321	28.886	28.855	28.900	28.880
5	46	70	55	57	92	57	87	.286	.416	.376	28.961	28.940	28.869	28.923
6	55	61	50	55⅓	87	77	100	.376	.413	.361	28.593	28.505	28.654	28.584
7	47	62	57	55⅓	85	72	75	.278	.399	.350	28.874	28.928	28.929	28.910
8	56	65	63	62	88	78	72	.422	.483	.416	28.896	28.855	28.795	28.848
9	58	69	51	59⅓	88	65	79	.423	.462	.296	28.883	28.997	29.053	28.978
10	52	73	63	62⅔	86	81	83	.334	.655	.478	29.087	29.046	29.037	29.056
11	51	76	59	62	93	73	82	.348	.652	.410	29.059	29.005	28.967	29.010
12	58	78	58	64⅔	94	82	88	.452	.785	.423	28.970	28.904	28.877	28.917
13	52	65	56	57⅔	93	94	94	.361	.583	.420	28.806	28.705	28.535	28.682
14	40	41	43	41⅓	100	100	88	.348	.257	.231	28.287	28.330	28.613	28.390
15	42	43	32	39	74	75	79	.199	.209	.143	28.953	29.106	29.284	29.098
16	26	50	34	36⅔	100	53	79	.141	.210	.155	29.344	29.325	29.300	29.323
17	34	53	36	42⅔	79	53	90	.155	.255	.191	29.351	29.366	29.317	29.345
18	33	62	39	44⅓	100	46	82	.181	.256	.195	29.378	29.312	29.314	29.335
19	41	64	50	51⅔	100	53	78	.257	.314	.283	29.279	29.203	29.129	29.203
20	49	56	40	48⅓	100	94	91	.348	.420	.225	29.059	29.026	29.172	29.086
21	36	55	43	44⅔	100	68	83	.212	.295	.231	29.113	29.121	29.114	29.116
22	54	61	48	54⅓	74	61	92	.308	.325	.310	29.114	29.053	29.045	29.070
23	45	67	54	55⅓	100	75	93	.300	.489	.390	29.028	28.943	28.770	28.913
24	52	45	39	45⅓	86	68	68	.334	.204	.152	28.641	28.812	28.982	28.812
25	29	48	38	37⅔	88	56	81	.142	.189	.186	29.070	29.044	28.972	29.028
26	43	45	45	44⅓	93	100	84	.254	.300	.251	28.744	28.794	28.781	28.773
27	42	49	40	43⅔	91	71	78	.244	.247	.182	28.955	28.942	28.899	28.932
28	31	37	35	34⅓	89	53	62	.155	.116	.127	28.882	28.979	29.113	28.991
29	34	36	28	32⅔	79	61	76	.155	.129	.117	29.284	29.301	29.325	29.303
30	29	40	33	34	77	64	60	.123	.160	.118	29.338	29.317	29.203	29.286
31	34	53	48	45	79	54	56	.155	.219	.189	29.040	28.993	28.950	28.994
Sums														
Means				49.7	89.4	71.6	81.1	.281	.373	.279				28.980
Average						80.7			.311					

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OCTOBER, 1893, AT AGRICULTURAL COLLEGE, MICHIGAN.

Clouds.						Winds.						Registering thermom'r.		Rain and snow.			
7 A. M.		2 P. M.		9 P. M.		7 A. M.		2 P. M.		9 P. M.							
Per cent of cloud.	Kind.	Per cent of cloud.	Kind.	Per cent of cloud.	Kind.	Direction.	Force.	Direction.	Force.	Direction.	Force.	Maximum.	Minimum.	Beginning, rain or snow.	Ending, rain or snow.	Inches of rain or melted snow.	Depth of snow, inches.
00	.....	00	.....	00	.....	s e	1	s w	1	....	0	72	48				
100	Cir. St.	40	Cir.	100	St.	s e	7	s e	10	s e	3	78	52	In night.	.....	.28	.....
100	St.	100	St.	100	St.	w	2	w	2	w	1	62	40	.....	In night.	.79	.....
00	.....	10	Cir. St.	5	Cu. St.	w	2	s w	1	....	0	68	42	.....	.....	.....	.....
00	.....	00	.....	00	.....	....	0	s e	18	s e	13	72	44	.....	.....	.....	.....
40	Cu.	100	Cu. St.	100	St.	s e	15	s e	19	s w	17	67	45	7:45 A. M.	.....	.13	.....
5	Cu.	10	Cu.	3	Cu. St.	s w	10	s w	3	s e	2	67	52	.....	4 P. M.	.07	.....
90	Cir. Cu.	100	Cu. St.	00	.....	s e	3	s e	5	s	7	68	53	.....	.....	.....	.....
00	.....	00	.....	00	.....	s	5	s w	5	e	5	72	45	.....	.....	.....	.....
20	Cu.	00	.....	00	.....	s e	5	s e	9	s e	2	77	46	.....	.....	.....	.....
00	.....	10	Cir.	00	.....	s	2	s	13	....	0	83	50	.....	.....	.....	.....
15	Cir.	10	Cu.	00	.....	s	1	s e	8	....	0	84	48	.....	.....	.....	.....
95	Cu. St.	100	St.	100	St.	s e	2	s e	1	....	0	65	40	7 P. M.	.....	.....	.....
100	St.	100	St.	100	St.	s w	16	n w	18	w	12	42	39	.....	.....	1.30	.....
100	St.	100	Cir. St.	00	.....	n w	12	w	10	....	0	50	22	.....	In night.	.20	.....
00	.....	00	.....	..	.....	....	0	w	6	w	3	57	28	.....	.....	.....	.....
00	.....	00	.....	00	.....	s	2	s e	5	....	0	64	27	.....	.....	.....	.....
00	.....	00	.....	00	.....	....	0	s e	7	s e	2	65	33	.....	.....	.....	.....
5	Cir. Cu.	40	Cir.	100	Cir.	s e	2	s w	8	s w	4	70	40	In night.	.....	.....	.....
100	Cu. St.	100	Cu. St.	00	.....	s w	3	s w	5	s w	3	60	30	.....	11 A. M.	.28	.....
00	Fog.	00	.....	00	.....	s w	2	s w	3	....	0	60	33	.....	.....	.....	.....
00	.....	00	.....	00	.....	s w	7	s	10	s	3	65	39	.....	.....	.....	.....
00	.....	10	Cu.	00	.....	s e	2	s e	8	s w	10	70	42	.....	.....	.....	.....
3	Cir.	100	Cu.	50	Cir. Cu.	s e	6	s e	13	....	0	45	25	.....	.....	.....	.....
25	Cir. Cu.	5	Cir.	100	Cir. St.	....	0	e	4	s e	5	53	25	In night.	.....	.....	.....
100	St.	100	St.	100	St.	s e	7	s e	6	w	3	50	37	.....	5 P. M.	.48	.....
100	Cu. St.	100	Cu. St.	80	Cir. St.	w	3	s w	8	s w	14	52	30	In night.	.....	.08	.....
100	Cu. St.	100	Cu. St.	100	Cu. St.	s w	6	n w	11	w	8	40	30	.....	.....	.....	.....
60	Cu. St.	95	Cu. St.	15	Cu. St.	n w	5	n w	8	n w	2	39	23	.....	.....	.....	.....
35	Cu. St.	100	St.	00	.....	s	3	s w	8	s w	7	44	24	.....	.....	.....	.....
50	Cu. St.	100	Cir. St.	20	Cu. St.	s w	12	s w	17	s e	13	57	33	.....	.....	.....	.....
----	.....	----	.....	----	.....	----	----	----	----	----	----	.....	.....	.....	.....	3.61	.....
44.9	.....	51.0	.....	37.9	.....	----	----	----	----	----	----	61.5	37.6	.....	.....	.....	.....
		44.6%				----	----	----	----	----	----	.....	.....	.....	.....	.....	.....

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METEOROLOGICAL OBSERVATIONS FOR THE MONTH OF

Day of Month.	Thermometer in open air.				Relative humidity or per cent of saturation.			Pressure of vapor in inches.			Barometer reduced to freezing point.			
	7 A. M.	2 P. M.	9 P. M.	Daily mean.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.	Mean.
1	50	53	48	50½	58	80	78	.210	.321	.260	28.935	28.909	28.905	28.916
2	52	59	40	50½	60	65	64	.232	.323	.160	28.852	28.764	28.867	28.827
3	24	37	32	37¾	100	81	79	.129	.178	.142	29.031	29.051	29.068	29.050
4	23	47	29	33	100	48	88	.123	.156	.142	29.016	28.999	29.022	29.012
5	40	53	36	43	91	87	71	.225	.376	.149	29.069	29.051	29.111	29.077
6	29	60	39	42¾	100	44	78	.160	.229	.173	29.192	29.203	29.201	29.198
7	33	61	43	45¾	100	50	75	.188	.269	.209	29.194	29.130	29.128	29.151
8	37	54	34	41¾	90	74	100	.199	.308	.196	29.146	29.125	29.148	29.139
9	28	44	43	38½	100	100	92	.153	.289	.254	29.127	29.151	29.134	29.137
10	42	53	40	45	91	80	100	.244	.321	.248	29.146	29.150	29.188	29.161
11	42	50	43	45	100	85	59	.267	.309	.164	29.216	29.194	29.143	29.184
12	48	53	43	48	85	83	100	.295	.328	.278	29.114	29.114	28.944	29.057
13	35	42	34	37	90	66	71	.183	.177	.138	28.956	28.986	28.983	28.975
14	30	33	28	30½	89	89	100	.148	.168	.153	28.971	28.888	28.880	28.913
15	22	27	24	24½	100	100	100	.118	.147	.129	28.791	28.780	28.830	28.800
16	11	32	35	26	79	100	80	.057	.181	.162	28.901	28.864	28.756	28.873
17	45	50	36	43¾	61	65	90	.182	.224	.191	28.781	28.711	28.873	28.773
18	24	29	30	27¾	86	88	100	.111	.142	.167	29.012	29.067	28.993	29.024
19	30	30	28	29½	100	100	100	.167	.167	.158	28,968	28.933	28.999	28.955
20	25	36	32	31	100	71	89	.135	.149	.162	29.049	29.025	28.908	28.994
21	33	33	33	33	100	100	100	.188	.188	.188	28.665	28.480	28.382	28.492
22	34	35	32	33¾	89	80	100	.175	.162	.181	28.424	28.504	28.743	28.557
23	26	28	21	25	100	100	85	.141	.158	.096	28.823	28.815	29.036	28.891
24	20	24	20	21½	100	100	100	.106	.129	.108	29.055	29.009	29.363	29.142
25	18	24	13	25	84	100	81	.062	.129	.067	29.316	29.359	29.418	29.363
26	24	33	33	30	100	89	80	.129	.168	.150	29.403	29.245	29.152	29.266
27	34	37	35	35½	100	100	55	.196	.221	.131	28.896	28.713	28.464	28.691
28	34	35	32	33¾	100	54	100	.196	.123	.181	28.638	28.740	28.814	28.731
29	35	37	33	35	100	100	89	.204	.221	.168	28.684	28.613	28.847	28.715
30	31	30	20	27	89	100	85	.155	.167	.091	28.904	28.859	28.915	28.893
Sums														
Means				35.63	91.4	82.6	86.1	.169	.214	.166				28.998
Average						86.7			.183					

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NOVEMBER, 1898, AT AGRICULTURAL COLLEGE, MICHIGAN.

Clouds.						Winds.						Registering thermom'r.		Rain and Snow.			
7 A. M.		2 P. M.		9 P. M.		7 A. M.		2 P. M.		9 P. M.							
Per cent of cloud.	Kind.	Per cent of cloud.	Kind.	Per cent of cloud.	Kind.	Direction.	Force.	Direction.	Force.	Direction.	Force.	Maximum.	Minimum.	Beginning, rain or snow.	Ending, rain or snow.	Inches of rain or melted snow.	Depth of snow, inches.
98	Cu. St.	10	Cu.	00	.....	s e	10	s w	14	s w	11	55	43	.....	.....	.....	.....
50	Cir.	100	Cu. St.	15	Cir.Cu.	s e	8	s w	12	s e	4	61	22	5 p. m.	Night.	.03	.....
00	.....	00	.....	.....	.....	w	5	w	3	.....	0	47	20	.....	.....	.....	.....
00	.....	00	.....	10	Cir.Cu.	.....	0	w	2	.....	0	52	21	.....	.....	.....	.....
95	Cir.Cu.	00	.....	00	.....	s e	3	s w	11	s e	1	58	25	.....	.....	.....	.....
90	.....	.....	.....	.....	.....	s e	1	s e	9	s e	2	65	26	.....	.....	.....	.....
00	.....	00	.....	00	.....	s e	5	s e	9	.....	0	66	32	.....	.....	.....	.....
90	Cu.	10	Cir.	00	.....	.....	0	.....	0	.....	0	59	24	.....	.....	.....	.....
.....	.....	100	St.	100	St.	.....	0	.....	0	.....	0	47	24	.....	.....	.....	.....
100	St.	00	.....	100	St.	.....	0	.....	0	.....	0	57	28	.....	.....	.....	.....
100	St.	100	St.	00	.....	.....	0	s w	3	s w	7	53	33	.....	.....	.....	.....
100	St.	100	Cu. St.	100	Cu.	s w	5	s w	8	s w	13	55	33	5:30p.m.	In night,	.22	.....
100	Cu. St.	00	.....	00	.....	w	13	s w	14	s w	7	45	28	night.	.....	.....	¾
40	Cu.	100	Cu. St.	100	Cir.	s w	5	s w	12	s w	1	33	20	.....	.....	.....	.....
100	Cu. St.	100	Cu. St.	100	St.	s w	1	s w	11	s w	1	27	6	.....	In night,	.08	½
00	.....	100	Cir.	00	.....	.....	0	s w	9	s	17	49	30	.....	.....	.....	.....
00	.....	90	Cir.	100	Cu. St.	s	15	s w	17	s w	7	53	33	.....	.....	.....	.....
00	.....	100	St.	90	Cu.	s w	5	w	9	s w	6	33	20	.....	.....	.....	.....
100	Cu. St.	100	Cu. St.	00	.....	n w	9	n w	11	n w	3	33	14	.....	.....	.....	.....
100	Cu.	100	Cu.	00	.....	s w	2	s w	3	.....	0	38	33	.....	.....	.....	.....
100	St.	100	St.	100	St.	s e	3	s e	5	s	22	35	30	10 a. m.	.....	.35	1
100	St.	100	St.	100	St.	s w	18	s w	20	s w	8	35	24	.....	.....	.....	.....
100	St.	100	St.	100	Cu. St.	w	11	w	7	w	5	29	17	.....	.....	.....	.....
100	St.	80	Cu.	100	Cu.	w	5	n w	10	n w	4	26	15	.....	.....	.....	.....
100	Cu. St.	100	Cu. St.	40	Cir.	w	5	w	3	.....	0	25	7	.....	.....	.....	.....
100	St.	100	Cir.	100	St.	s e	13	s e	16	s e	8	35	33	In night,	.....	.....	.....
100	St.	100	St.	100	St.	s e	13	s e	13	s e	13	47	31	.....	In night.	.83	.....
100	Cu. St.	100	Cu. St.	100	St.	s w	15	s w	14	s w	2	35	23	.....	.....	.....	.....
100	St.	100	St.	100	St.	s	4	.....	0	w	5	37	33	6 p. m.	.....	.....	.....
100	St.	100	St.	00	.....	w	6	s w	10	w	4	33	11	.....	6 p. m.	.09	¾
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	3.19	3
66.4	.....	69.6	.....	48.5	.....	.....	.....	.....	.....	.....	.....	43.7	23.1	.....	.....	.....	.....
61.5						.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

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METEOROLOGICAL OBSERVATIONS FOR THE MONTH OF

Day of month.	Thermometer, in open air.				Relative humidity, or per cent of saturation.			Pressure of vapor, in inches.			Barometer, reduced to freezing point.			
	7 A. M.	2 P. M.	9 P. M.	Daily mean.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.	Mean.
1	14	17	10	13⅔	100	83	78	.082	.078	.054	29.008	29.064	29.084	29.052
2	10	17	16	14⅓	100	100	100	.068	.094	.090	29.138	29.068	28.908	29.043
3	19	30	19	22⅔	100	100	84	.103	.167	.087	28.775	28.859	29.005	28.879
4	9	20	18	15⅔	100	85	84	.065	.091	.082	29.116	29.193	29.056	29.122
5	23	35	20	26	86	80	85	.106	.162	.091	28.941	28.982	28.941	28.971
6	19	32	19	23⅓	100	29	69	.103	.052	.071	29.074	29.105	29.119	29.099
7	14	19	17	16⅔	81	84	83	.067	.087	.078	29.161	29.220	29.199	29.173
8	27	37	26	30	88	62	75	.129	.136	.105	29.024	28.970	28.967	28.987
9	32	39	34	35	89	100	100	.162	.238	.196	28.838	28.669	28.595	28.701
10	25	26	16	22⅓	87	87	83	.117	.123	.074	28.832	28.858	29.033	28.907
11	13	27	27	22⅓	81	88	77	.063	.129	.123	29.111	28.827	28.746	28.895
12	25	23	19	22⅓	74	86	69	.100	.106	.071	29.051	29.139	29.392	29.194
13	14	21	11	15⅔	81	85	79	.067	.096	.057	29.504	29.597	29.558	29.553
14	21	28	32	27	100	76	100	.113	.117	.181	29.261	29.148	28.930	29.113
15	35	44	45	41⅓	100	100	100	.204	.289	.300	28.744	28.610	28.471	28.608
16	32	28	29	29⅔	100	100	88	.181	.153	.142	28.472	28.546	28.877	28.632
17	27	27	24	26	88	88	100	.129	.129	.129	28.887	28.927	28.898	28.902
18	14	28	32	24⅔	100	100	89	.182	.153	.162	28.664	28.434	28.416	28.505
19	24	24	16	21⅓	78	73	65	.094	.094	.059	28.744	28.909	29.297	28.983
20	17	23	22	20⅔	83	72	71	.078	.089	.084	29.295	29.290	29.156	29.247
21	29	39	35	34⅓	77	63	80	.122	.152	.162	29.043	29.016	29.097	29.053
22	37	42	48	42⅓	81	100	100	.178	.267	.335	29.055	28.977	28.899	28.977
23	41	48	40	43⅓	91	78	100	.235	.260	.248	29.001	29.073	29.237	29.100
24	45	57	50	50⅔	100	75	100	.300	.350	.361	29.197	29.057	29.085	29.113
25	53	55	25	44⅓	86	100	100	.348	.433	.135	28.871	28.991	29.126	28.996
26	17	22	25	21⅓	100	86	87	.094	.101	.117	29.455	29.488	29.449	29.464
27	31	35	25	30⅔	89	80	87	.155	.162	.117	29.096	28.989	28.849	28.975
28	38	42	36	38⅔	100	91	80	.229	.244	.170	28.504	28.446	28.478	28.474
29	32	28	20	26⅔	79	88	70	.143	.135	.075	28.630	28.746	28.919	28.785
30	20	22	21	21	85	71	85	.091	.084	.096	28.984	28.982	28.960	28.975
31	19	27	22	22⅔	84	88	71	.087	.129	.084	28.996	28.976	29.156	29.053
Sums														
Means				27.6	89.7	80.9	79.3	.135	.157	.591				28.984
Average						83.3			.294					

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DECEMBER, 1898, AT AGRICULTURAL COLLEGE, MICHIGAN.

Clouds.						Winds.						Registering Thermometer.		Rain and snow.			
7 A. M.		2 P. M.		9 P. M.		7 A. M.		2 P. M.		9 P. M.							
Per cent of cloud.	Kind.	Per cent of cloud.	Kind.	Per cent of cloud.	Kind.	Direction.	Force.	Direction.	Force.	Direction.	Force.	Maximum.	Minimum.	Beginning, rain or snow.	Ending, rain or snow.	Inches of rain or melted snow.	Depth of snow, inches.
100	St.	100	Cu. St.	00	.....	n w	4	w	7	w	1	19	6	.....	.....	.....	.....
100	St.	100	St.	100	St.	w	1	s e	5	s e	2	18	11	8 a. m.	In night	.36	6
100	St.	100	St.	100	Cu. St.	n w	3	n w	5	s e	1	20	—8	.....	.....	.....	.....
100	St.	5	Cu.	00	.....	----	0	n w	9	s e	12	20	6	.....	.....	.....	.....
100	Cir. St.	40	Cu.	100	Cu. St.	s	14	s w	3	s w	5	35	14	.....	.....	.....	.....
100	St.	100	St.	100	Cir.	s w	3	s w	10	s w	2	32	9	7 a. m.	10 a. m.	.....	⅛
100	St.	80	Cir.	00	.....	s w	2	s w	1	s e	12	26	15	In night	.....	.....	.....
100	St.	100	St.	00	.....	s e	10	s e	11	s e	3	45	17	.....	8 a. m.	.09	¼
100	St.	100	St.	100	St.	e	3	s e	6	s w	18	40	25	.....	.....	.....	.....
100	St.	100	St.	80	Cir.	s w	14	s w	12	w	1	26	1	.....	.....	.....	.....
100	St.	100	St.	80	Cir.	s e	4	s e	1	s e	11	28	9	7 a. m.	1:30 p m	.....	2½
100	St.	100	St.	100	St.	n w	10	n w	10	n w	1	25	—8	12:30 pm	1:30 p m	.....	⅛
100	St.	90	Cu.	100	Cir.	----	0	e	1	e	5	22	0	In	night.	.35	1
100	St.	100	St.	100	St.	e	13	e	7	e	3	35	32	In night	.....	.....	.....
100	St.	100	St.	100	St.	e	5	s w	11	s w	20	47	28	.....	In night	.70	.....
100	St.	100	Cu. St.	----	.....	w	21	w	13	w	7	45	20	.....	.....	.....	.....
100	St.	80	Cu.	100	St.	s w	5	s w	5	w	13	30	10	In night	.....	.....	.....
100	St.	100	St.	100	Cu. St.	s w	14	s w	16	s w	13	33	19	.....	In night	.11	3
100	Cu. St.	100	Cu. St.	00	.....	s w	12	n w	11	----	0	26	5	.....	.....	.....	.....
60	Cu.	40	Cu.	00	.....	s w	8	s w	15	s w	16	42	17	.....	.....	.....	.....
80	Cir.	80	Cu.	100	Cir. St.	s w	15	s w	13	s w	4	43	23	.....	.....	.....	.....
100	Cu. St.	100	Nim.	100	Cu. St.	s	4	s	11	s w	11	46	35	12 m.	4 p. m.	.19	.....
00	.....	5	Cir.	100	Cu.	s w	9	s w	7	s w	10	57	33	In night	6 a. m.	.22	.....
40	Cir Cu.	100	Cu.	100	Cu. St.	s w	9	s w	9	s w	16	62	59	.....	.....	.....	.....
10	Cir.	100	Cu.	100	Cu. St.	s w	11	s w	15	n e	6	55	15	3 p. m.	In night	.10	.....
100	Cu. St.	10	Cu.	100	Cu. St.	n w	5	w	5	w	16	30	16	.....	.....	.....	.....
90	Cu.	5	Cu.	00	.....	s w	18	w	13	w	9	43	25	In night	.....	.....	.....
100	Nim.	100	St.	100	Cir Cu.	s w	13	s w	10	s w	4	42	26	.....	In night	.14	.....
100	Cu. St.	100	Cu. St.	100	St.	n e	3	n e	2	n e	5	28	17	.....	.....	.....	.....
100	Cu. St.	100	Cu. St.	100	Cir. St.	n e	4	n e	5	n e	8	27	15	.....	.....	.....	.....
00	.....	100	St.	00	.....	s w	12	s w	17	s w	1	29	16	12 m.	3 p. m.	.02	⅛
----	.....	----	.....	----	.....	----	----	----	----	----	----	.....	...	.....	.....	2.28	13¼
86.4	.....	80.1	.....	69.6	.....	----	----	----	----	----	----	34.6	16	.....	.....	.....	.....
			78.7			----	----	----	----	----	----	.....	.....	.....	.....	.....	.....

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EXPERIMENT STATION BULLETINS.

Bulletin 101.—Chemical Department.

I.—Composition of wheat at different periods of ripening; of the straw at the same periods.
II.—Composition of certain forage plants: Spurry: Lathyrus Silvestris: Mint hay.
III.—Adulteration of ground feed.
IV.—Mineral residues in sprayed fruit.

I. COMPOSITION OF CLAWSON WHEAT AT DIFFERENT PERIODS OF RIPENING.

Thirteen years ago the chemical department of this college made an investigation to determine the composition of wheat at successive stages of ripening, with special reference to the time at which are developed the greatest quantity of grain and the highest food value of the same. The results were published in the Report of the Board of Agriculture for 1881, and were also printed in the U. S. Census for 1880. This was before the era of bulletins of experiment stations, and reached only a small part of the farming public. The subject is so important and far-reaching in its consequences that this experiment station decided to make another and more extended investigation on this subject. This was made with special reference to the conditions and demands of Michigan farming.

The experiment began by gathering a bundle of wheat at 2 P. M., June 14, 1892, and another similar bundle at the same hour for 45 successive days, ending on July 29. The bundles were gathered in a field of wheat of very uniform appearance and quality, securing a fair representative of the growing crop. The wheat had headed out and was in blossom, but the berry was still very immature. The successive bundles of wheat were labeled and placed in a dry and well ventilated room to secure what ripening and development were possible from the nutritive material in the stalk. When thoroughly dry, the grain was rubbed out by hand, screened, and bottled for analysis. The straw was reserved for separate analysis. Separate specimens of wheat from these consecutive cuttings were

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mounted in show bottles and exhibited at the Columbian Fair in the Michigan Agricultural College exhibit in Hall of Liberal Arts, and at the close of the Columbian Fair will be on exhibition at the chemical laboratory of the Agricultural College.

The cutting of the wheat was begun when the grain was very immature, the berry just formed, and the development finally reached by this grain was mostly due to growth after cutting and before drying of the stalk. The cutting was begun at this early date in order to estimate the value of the straw for fodder at different periods. As we have no records of the feeding value of straw at different periods of ripening, it was thought that this subject demanded consideration in a State where the value of straw in stock feeding is recognized.

RELATIVE QUANTITY OF GRAIN AT EACH TIME OF CUTTING.

The amount of grain as influenced by the period of cutting is a question of practical importance to the farmer. In making this estimate attention is confined to the weight of the dry berry, because variation in amount of grain attendant upon changes during growth arises from variation in the size and weight of the kernel and not from any variation in the number of grains growing on a given area. New kernels would not form during the period of ripening, and those already formed would pass through the successive stages of development more or less completely. In this way several sources of error were eliminated which are incidental to measuring the grain produced on a given area, such as loss of grain by shelling, and from incomplete threshing, the varying productiveness of different plots of soil, etc. All broken kernels and foreign substances were removed, but no kernels were rejected because of incomplete development. Ten grams were weighed out on a delicate balance and the grains carefully counted; this repeated up to ten times, and one-tenth of the sum of kernels in ten times ten grams was taken as the true number of grains for ten grams. The average product of grain at the several stages of growth would be directly as the weight of the kernels, and inversely as the number of kernels required to produce the given weight.

IRREGULAR PROGRESS IN GROWTH.

Some irregularities appear in the progressive development both of the grain and straw. These are partly to be explained by the climatic conditions prevailing during the period. There were two spells of cold and cloudy weather, fourth to seventh cutting (June 17 to 20), and again, the nineteenth to twenty-fourth cutting (July 2 to 7), when growth seemed to be nearly arrested for a time, when the mean temperature of the open air and of the soil at the depth of three inches show a marked decline in temperature for the season. The pause in the curve of summer growth in all the plant tissues is evidence of this control over their development by physical agencies even in the heart of summer.

For purposes of comparison, Table II includes the mean daily temperature of the open air, of the soil at depth of three inches, the highest and the lowest temperatures for each day, the amount of cloudiness, and the rainfall.

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TABLE I.

Analysis of Clawson wheat cut at intervals of 24 hours for 46 days, June 14 to July 29, 1892. Results calculated for dry substance.

No. of cutting.	No. of kernels in 10 grams.	Ash.	Ether extract.	Crude fiber.	N. free extract.	Crude protein.	Total albuminoids.	Amides.	Condition of crop at time of gathering specimens.
1	1,706	4.72	2.42	4.85	51.79	36.22	27.09	9.13	Just out of blossom; grain set.
2	1,770	4.70	2.39	4.99	53.04	34.88	26.77	8.11	No apparent change.
3	1,365	4.13	2.30	4.38	59.61	29.58	24.38	5.20	Grain a trifle larger.
4	1,267	3.89	2.35	4.26	60.16	29.34	23.43	5.91	Straw slightly yellow at butt.
5	1,083	3.94	2.35	3.86	61.28	28.57	23.85	4.72	Grain full of sweet sap.
6	1,032	3.58	2.18	4.15	65.16	24.93	20.18	4.75	Grain about half size; sweeter.
7	1,036	3.42	2.26	4.06	67.48	22.76	17.98	4.78	Starch grains appear.
8	856	3.24	2.29	3.78	70.78	19.91	15.93	3.98	Straw turning yellow; grain more yellow.
9	780	2.93	2.35	3.39	72.22	19.10	14.44	4.66	Grain nearly full size.
10	701	2.66	2.29	3.29	74.04	17.72	14.49	3.23	Grain in milk; firmer.
11	621	2.69	1.87	3.28	77.14	15.02	12.85	2.17	Still in milk; firmer.
12	537	2.55	1.96	2.91	77.89	14.69	12.73	1.96	Grain the same; straw yellower.
13	499	2.89	2.13	2.77	78.10	14.61	12.17	2.44	Same.
14	463	2.43	2.12	2.57	78.41	14.47	12.58	1.89	Grain in milk; leaves drying up.
15	444	2.42	1.92	2.65	80.78	12.23	10.37	1.96	Stalks yellow; grain turning yellow.
16	412	2.37	2.25	2.48	80.84	12.06	10.33	1.73	Grain not so sappy.
17	389	2.30	2.00	2.84	81.25	12.11	10.41	1.71	Grain still milky; leaves dry; straw ripe at base.
18	363	2.35	2.05	2.28	81.01	12.31	10.83	1.48	Some grains milky; others doughy.
19	346	2.29	2.10	2.24	80.81	12.56	10.79	1.77	Same.
20	360	2.27	2.13	2.22	80.62	12.76	11.20	1.56	No change; restrained by rain.
21	326	2.25	2.18	2.18	81.51	11.98	10.72	1.26	" " "
22	307	2.19	2.11	2.11	82.02	11.57	10.16	1.41	Ripening rapidly; doughy.
23	301	2.14	2.14	2.15	81.88	11.69	10.30	1.39	Grain quite yellow.
24	290	2.07	2.07	2.01	82.04	11.51	10.22	1.58	Grain yellow and firmer.
25	271	2.14	2.20	2.04	81.89	11.73	11.02	.71	Field full yellow.
26	263	2.11	2.13	1.87	82.15	11.74	10.53	1.21	" " "
27	261	2.13	2.08	2.04	82.06	11.69	10.76	.93	Grain getting hard and flinty.
28	260	2.17	2.27	1.84	81.77	11.95	10.97	.98	Ready to cut.
29	253	2.13	2.18	1.93	81.87	11.89	11.03	.76	Grain harder; head turning brown.
30	248	2.11	2.22	2.04	81.80	11.83	11.03	.80	Straw ripe; grain getting dry.
31	255	2.11	2.17	1.85	81.49	12.38	11.30	1.08	Grain in some heads quite floury.
32	246	2.14	2.13	1.77	81.61	12.35	11.28	1.07	Straw all yellow; whole field ripe.
33	249	2.15	2.22	1.89	81.48	12.25	11.60	.65	Grain harder; shows more white flour.
34	250	2.19	2.16	1.94	81.76	11.95	11.09	.86	Shells out badly.
35	249	2.14	2.17	1.84	81.56	12.29	11.44	.85	Grain plump; no shrinkage.
36	249	2.09	2.17	1.83	81.83	12.08	11.15	.93	Some grains show shrinkage.
37	240	2.18	2.20	1.95	81.09	12.63	12.02	.61	Many kernels shrunken.
38	242	2.15	2.23	1.82	81.40	12.40	12.03	.37	Straw getting broken and a little rusty.
39	248	2.13	2.15	1.89	80.36	13.47	12.12	1.35	" " " "
40	247	2.08	2.15	1.98	80.91	12.88	11.80	1.08	Straw very rusty; grain hard enough to grind.
41	248	2.11	2.22	1.93	80.54	13.20	12.99	.21	Straw nearly all broken down; getting mouldy; very tender.
42	251	2.12	2.26	1.97	81.05	12.60	11.86	.74	
43	248	2.12	2.28	1.96	80.82	12.82	11.80	1.02	
44	245	2.07	2.22	1.89	80.98	12.84	11.84	1.02	
45	249	2.07	2.18	1.95	80.96	12.84	11.61	1.23	
46	251	2.11	2.24	2.01	80.74	12.90	11.90	1.00	

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TABLE II.

Analysis of wheat straw at 46 successive daily cuttings, June 14 to July 29, 1892.

No. of cutting.	Ash.	Ether extract.	Crude fiber.	N. free extract.	Crude protein.	Albuminoids.	Amides.	Climatic conditions during period of growth.					
								Mean temperature of open air.	Highest temperature for the day.	Lowest temperature for the day.	Temperature of soil three inches deep.	Percentage of cloudiness.	Rainfall in inches.
1	6.11	1.66	41.08	48.19	2.96	1.94	1.02	68½°	76°	58°	72½°	40	
2	6.17	1.60	41.11	48.16	2.96	1.94	1.02	72¼°	81°	65°	71½°	20	
3	6.64	1.53	39.87	49.50	2.46	1.88	.58	76°	87°	62°	74¾°	70	* .37
4	6.43	1.46	40.04	49.68	2.39	1.49	.90	72½°	81°	65°	77½°	66	
5	6.14	1.43	40.34	49.77	2.32	1.49	.83	68½°	74°	66°	73¾°	100	* .22
6	6.34	1.36	40.45	49.47	2.38	1.64	.74	69¾°	78°	65°	70°	70	* .33
7	6.06	1.24	40.20	50.07	2.43	1.62	.81	71¾°	81°	63°	71½°	40	
8	6.46	1.22	39.77	50.12	2.43	1.62	.81	71¾°	80°	65°	70¾°	50	.08
9	5.98	1.25	40.00	50.42	2.40	1.58	.87	69°	78°	65°	70°	100	* .50
10	6.09	1.17	41.28	49.00	2.46	1.60	.86	70½°	77°	61°	71½°	90	
11	5.75	1.19	37.97	52.70	2.39	1.65	.74	69¾°	77°	54°	70¾°	75	
12	5.59	1.16	38.76	52.11	2.38	1.65	.73	63°	71°	58°	68°	30	
13	5.81	1.09	40.17	50.60	2.33	1.60	.73	64¾°	74°	59°	70°	70	* .95
14	6.08	1.06	41.35	49.19	2.37	1.57	.80	59½°	68°	52°	66°	80	
15	5.42	1.11	37.44	53.59	2.44	1.58	.86	62¾°	72°	55°	66°	20	* .13
16	4.89	1.16	39.64	51.94	2.37	1.64	.73	63°	70°	57°	64°	35	
17	6.09	1.16	39.47	50.92	2.36	1.87	.49	58½°	69°	42°	63½°	35	
18	6.09	1.16	39.98	50.40	2.37	1.87	.50	58¾°	68°	48°	63°	30	
19	5.88	1.27	40.83	49.68	2.39	1.66	.68	56°	61°	53°	58½°	65	
20	5.67	1.22	42.42	48.88	2.31	1.66	.65	51½*	68°	45°	60½°	100	* .58
21	6.11	1.19	40.32	50.08	2.30	1.58	.72	61¼°	73°	48°	62¾°	60	* .88
22	6.39	1.33	40.02	49.94	2.32	1.66	.66	63¼°	75°	48°	68°	16	
23	5.76	1.32	41.37	49.25	2.30	1.66	.64	65½°	77°	52°	69°	5	
24	5.49	1.27	43.70	47.29	2.25	1.66	.59	67°	79°	51°	69¾°	0	
25	4.99	1.33	43.80	47.84	2.04	1.60	.44	68°	81°	59°	70°	6	
26	5.42	1.39	43.67	47.48	2.04	1.60	.44	71¾°	83°	59°	73°	30	
27	6.02	1.34	44.26	46.29	2.09	1.58	.51	74½°	88°	61°	74½°	45	
28	6.21	1.23	44.85	45.80	1.91	1.57	.34	76°	84°	62°	74½°	25	
29	5.68	1.19	45.38	45.96	1.84	1.42	.42	78½°	88°	65°	74½°	40	
30	5.15	1.26	45.34	46.48	1.77	1.42	.35	73½°	83°	57°	74½°	35	.03
31	5.14	1.23	45.88	45.88	1.87	1.42	.45	71¾°	82°	64°	75¾°	30	
32	5.49	1.17	45.60	45.82	1.93	1.40	.52	68½°	85°	45°	73¾°	10	
33	5.55	1.17	44.98	46.51	1.79	1.57	.22	60¾°	72°	47°	71½°	75	
34	5.46	1.17	45.75	45.76	1.86	1.66	.20	66°	78°	53°	71½°	25	
35	6.46	1.22	45.17	45.90	1.85	1.60	.25	67½°	79°	68°	73¾°	15	
36	6.20	1.20	45.31	45.52	1.77	1.64	.13	72½°	82°	62°	74¾°	55	.01
37	6.19	1.16	46.96	43.97	1.72	1.60	.12	74°	86°	55°	76°	15	
38	5.78	1.11	46.75	44.59	1.77	1.60	.17	74¼°	86°	64°	77½°	18	
39	6.17	1.06	46.71	44.21	1.85	1.64	.21	78°	90°	62°	79¾°	20	
40	6.15	1.07	46.90	44.71	1.77	1.65	.12	78¾°	92°	67°	80½°	40	
41	6.39	1.06	46.46	44.32	1.77	1.65	.12	83°	92°	67°	82½°	30	
42	6.71	1.07	47.03	43.48	1.71	1.58	.13	83½°	98°	73°	81¾°	15	
43	6.08	1.13	48.03	42.99	1.77	1.64	.13	83°	95°	71°	82½°	20	
44	6.19	1.05	47.22	43.77	1.77	1.64	.13	78°	91°	72°	82°	50	
45	5.70	1.10	46.27	45.17	1.76	1.64	.12	80½°	90°	69°	83°	25	* .90
46	4.80	1.12	48.21	44.12	1.75	1.64	.11	64½°	77°	52°	71°	80	* .10
								Total rainfall					4.32

* Thunder storms.

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DIAGRAM OF RESULTS OF ANALYSIS OF CLAWSON WHEAT AT 46 SUCCESSIVE CUTTINGS.

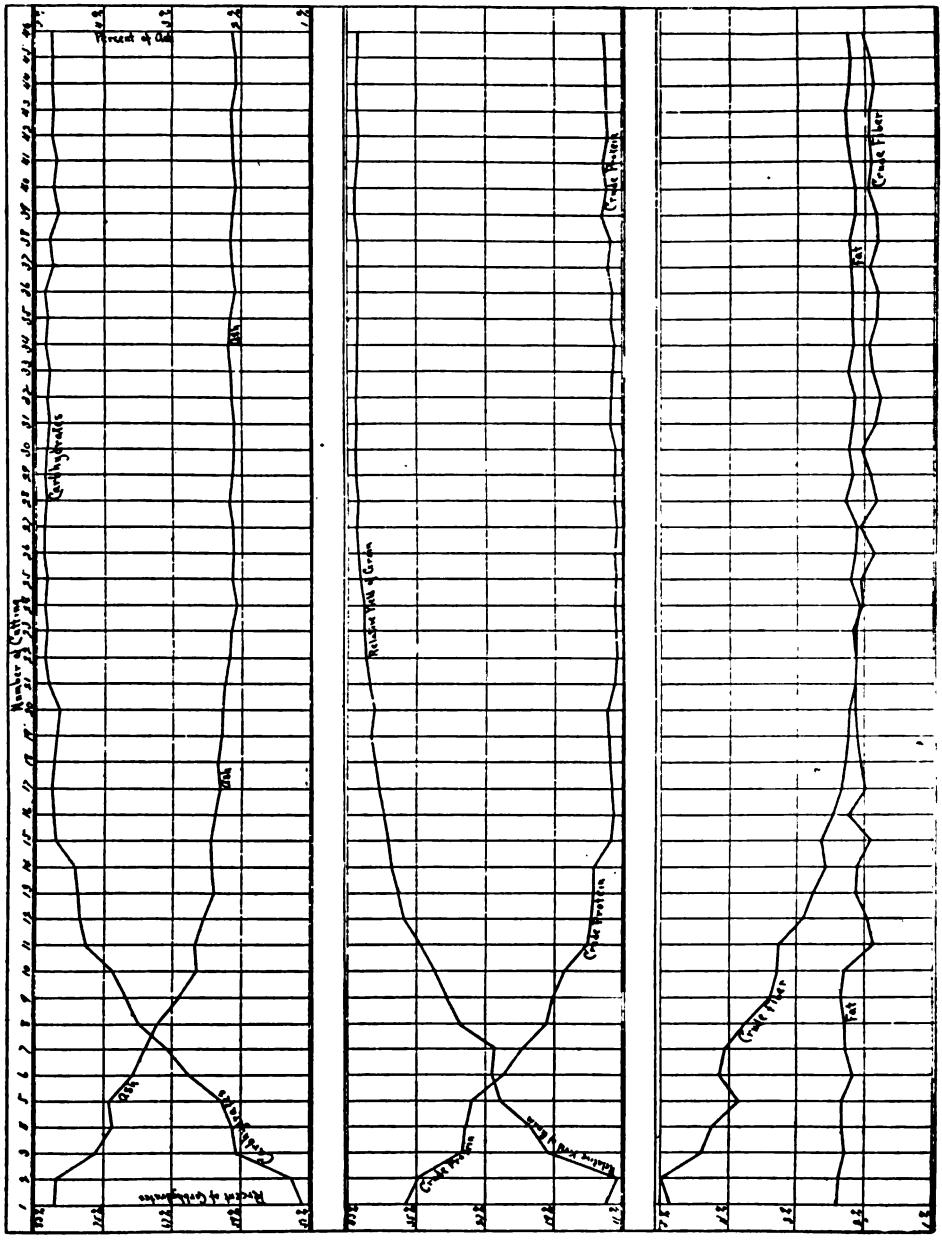

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DIAGRAM OF RESULTS OF ANALYSIS OF WHEAT STRAW AT 46 SUCCESSIVE CUTTINGS. II

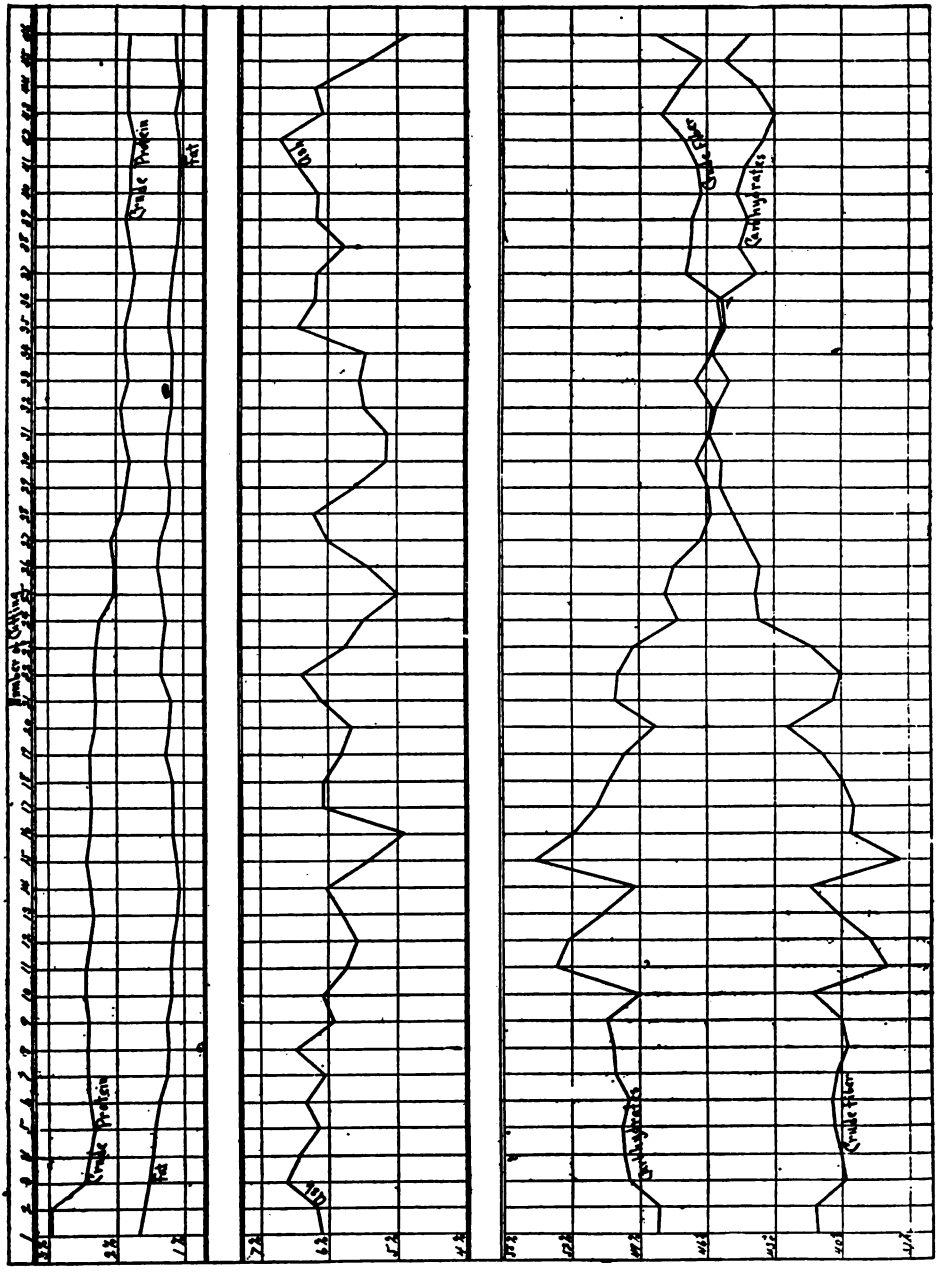

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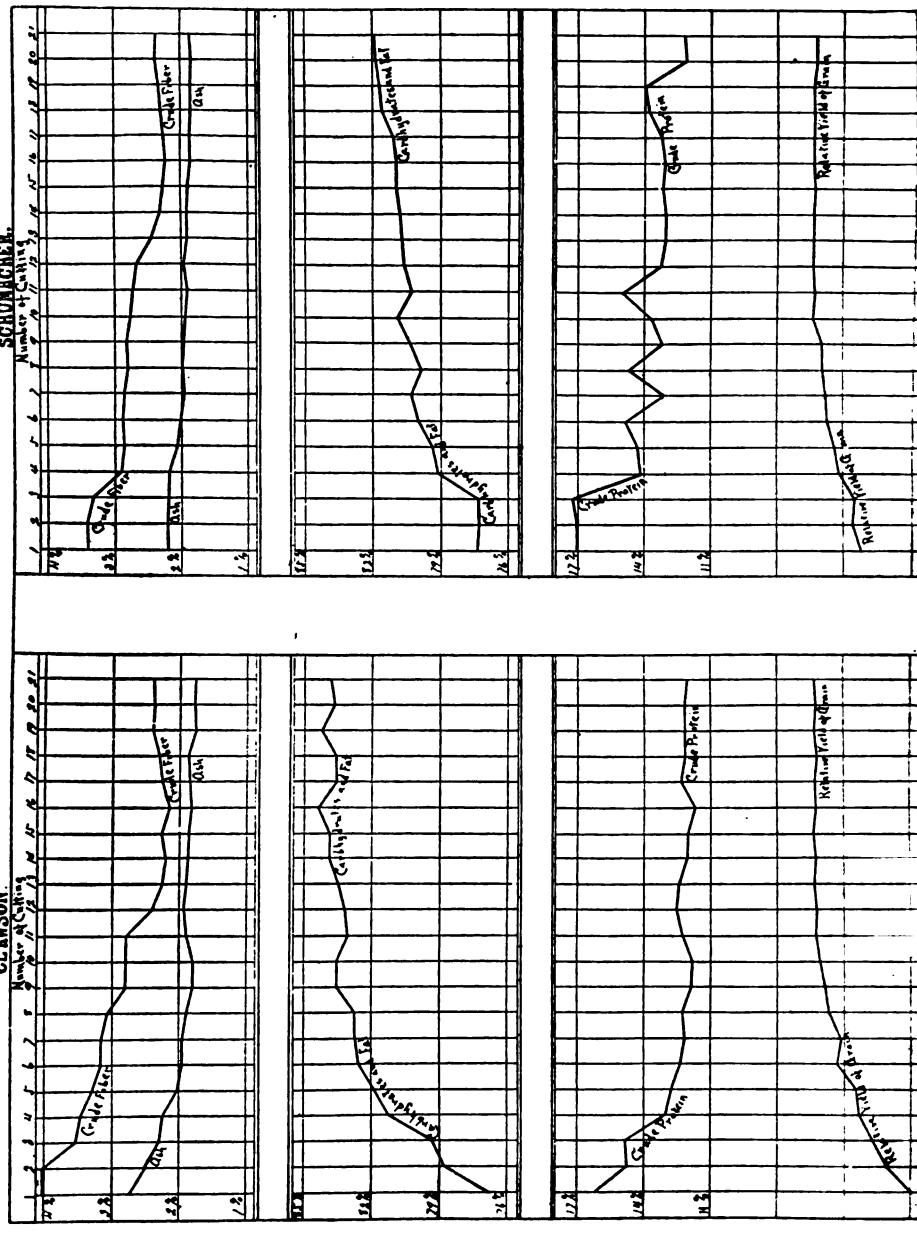
DIAGRAM OF RESULTS OF ANALYSIS OF WHEATS GROWN IN 1879. III



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In Tables I and II are given the results of analysis, with other data bearing on the subject. The results are calculated for *dry substance* in both tables to admit of more complete comparison in regard to essential changes in plant composition. The tables are on opposing faces of the bulletin to facilitate comparison.

DIAGRAMS.

In order to take in at a glance the successive changes in the growth of the plant, the results are given in diagrams so that the salient points in this investigation may be grasped without the necessity of keeping in mind a long array of tabular figures.

I. *The diagram of results of analysis of Clawson wheat at 46 successive cuttings*, requires a few words of explanation. With materials varying so widely as "fat" and "carbhydrates" it would be impossible to get all the materials on a diagram to one scale, and have all equally visible. Three scales are used for distinctness: the upper one for "carbhydrates," with the percentage scale at the left—from 51 to 83%, and "ash" with scale at the right—from 1 to 5%; the middle one for "crude protein" with scale at the left—from 11 to 43% and "relative yield of grain"—the greater the yield for the smaller number of kernels to weigh ten grams; in the lowest scale the "crude fibre" and "fat" are presented on the scale of 1 to 5%.

II. In the *Diagram of results of analysis of wheat straw at 46 successive cuttings*, a corresponding adjustment of vertical space for representation of percentages is made for each of the leading components of the straw, the percentage scale being found at the left.

III. A third *Diagram of results of analysis of wheats grown in 1879* is introduced for comparison with the results obtained from the wheat of 1892. In the Clawson and the Schumacher wheats of 1879, the period of development at the beginning of the cuttings was much more advanced than in the Clawson of 1892, and there was less climatic disturbance during the season of growth.

DEFINITION OF TERMS.

Before proceeding to the discussion of the results of analysis given in the tables, it may be proper to define some of the terms used in the tables.

Ash is the mineral matter remaining when the organic substance is completely burned with free access of air. It is the source of the mineral matter for bones, etc., of the animal system.

Ether-extract is the material dissolved out of the grain or straw by common "sulphuric ether." It is entered in the Diagrams as *fat*. It consists principally of fat, but contains a small amount of wax, coloring matter, etc.

Crude fibre is the woody part of the plant, insoluble in weak solutions of acids and alkalies at boiling heat. While a portion of crude fibre is digestible, it is the least valuable part of the plant. The crude fibre of the older parts of plants is nearly indigestible.

N-Free extract represents the carbonaceous part of food which is free of nitrogen. It consists largely of starch, sugar, gum, etc., and is considered of value equal to starch. It forms the largest part of vegetable foods and fodders. It is entered as carbhydrates in the diagrams.

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Crude protein. It was formerly supposed that all the nitrogen in food material existed in the form of protein or albuminoids—substances resembling albumen. But it was found that some of the organic nitrogen existed in a less highly organized form than the albuminoids. Hence the term *crude protein* was used to include all the unoxidized nitrogenous compounds of fodders and forage plants.

Albuminoids are substances resembling albumen in composition and food value.

Amides are the parts of crude protein which are less organized than albumen, such as asparagin of the asparagus plant. The amides are of less value as food than the albuminoids, but their value is not definitely settled at present. They seem to be most abundant during the earlier stages of plant growth.

PROGRESS IN GROWTH OF THE WHEAT BERRY.

With these definitions in mind a glance at Diagram I will enable a person to see the progressive development of the wheat grain from day to day, the relation of these changes to greatest food value and the time of maximum yield of grain; also the deterioration of the grain by overripening.

COMPOSITION OF WHEAT STRAW.

Wheat straw is of so little value in comparison with the grain that no consideration has been given to the straw in determining the best time for harvesting, yet an examination of Table II and Diagram II shows that in the earlier stages of growth the straw compares favorably with hay; but at later stages of growth its value diminishes rapidly, especially when we remember that the old and consolidated crude fibre is less digestible.

Attention is directed to the changes in cuttings 1 to 22 as shown in Table II and Diagram II. The fat falls off one-third of a per cent (even one-half per cent during the cold spell of 13th to 18th cuttings) the carbhydrates increase nearly two per cent, the crude protein falling off two-thirds of one per cent.

At the 22d cutting the straw compares favorably with the earlier cuttings in food value for stock. This is the time when the "wheat is in the dough" and the grain ripened perfectly after cutting. The grain is ripe at this stage, or when the kernel will "crush dry" and leave no watery stain when crushed between the thumb nails. From this period onward there is a progressive degradation both of the grain and of the straw. There is a falling off in fat, carbhydrates and protein in the straw and an increase of woody fibre with decreasing digestibility.

It is a matter of common observation with farmers that stock would not eat the dead ripe straw as readily as they would the brighter straw of earlier cuttings. We see the sufficient reason for this lack of relish in the fact that the straw is poor in chemical composition and less easy of digestion. The interesting fact also appears that if the crop is harvested as soon as the grain is fully matured there is little loss of feeding value in the straw. While the grain gains nothing by dead-ripening, the straw rapidly loses value by overripening.

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II. CERTAIN FORAGE PLANTS.

The experiment station was established in 1888. One of the first subjects to which attention was directed under the able leadership of Director Willets was the Jack Pine plains of the north-central part of our peninsula. The fact that the State held some 2,000,000 acres of these apparently worthless lands made the subject one of importance to our people, and the fact that the College held some 40,000 acres of the same lands as part of its endowment fund, gave additional interest to the problem of the plains.

In the outset it was proposed to find what these lands were capable of doing under the influence of a large variety of plants. For this purpose a large number of plants were sown, not with the expectation that all of them would succeed, but to meet in advance the criticism of those who would object that such and such a plant had not been tried. To settle the matter at the outset that certain plants would fail might save a large amount of subsequent inquiry and experimenting. It is not a valid criticism to say that many plants were tried that did not succeed. A decisive negative is often a valuable part of an experiment.

SPURRY.

Among the plants tried on the experimental farm at Grayling was spurry. Through the house of J. M. Thorburn & Co. of New York, I imported the seeds of spurry from Vilmorin Andrieux & Co. of Paris, and the first sowing of spurry in this State, if not in this country, was at Grayling.

In the light sands of the plains it has proved such a success that it has been difficult to supply the demand for the seed in the Jack Pine district, but it is rapidly spreading in that region, and gives great satisfaction wherever tried. A word of caution is needed for rich soils, *because the spurry forms seeds so rapidly and scatters them so freely that there is danger of its becoming a troublesome weed in rich soils.* But on light sands where few plants grow with vigor, a thrifty and rapidly growing weed is a godsend.

HOW TO GET SPURRY SEED.

To save correspondence, I may say that the College has no spurry seed to sell or to give away. Some seed can probably be obtained of Dr. Palmer of Grayling. I have also made arrangements with J. M. Thorburn & Co., 15 John St., New York, who will send by mail to any address a pound of spurry seed on receipt of 28 cents. A pound is enough for a trial and if it succeeds you can soon raise enough seed for your own use.

The value of some of the grasses and of spurry is set forth in the following letter to the Director of the experiment station by Dr. Palmer of Grayling, who has from the first taken a lively and intelligent interest in these experiments:

Grayling, Mich., Sept. 6, 1893.

Prest. L. G. Gorton, Director Experiment Station:

DEAR SIR—Your inquiry in regard to the success of the experiment station here can not be fully answered in a letter, but of the grasses which have proved successful in these light burned soils I mention Red Fescue,

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Sheep's Fescue, Tall Meadow Oat Grass and Orchard Grass. The Fescues are slow of growth but make a very even sward, and excellent pasturage when established, and fill the earth with roots which promise excellent results as fertilizers for future crops. They do not cut a heavy growth of hay and must be cut early, or it is woody. The Tall Meadow Oat Grass must be sown very thickly on this soil; it grows very even over four feet in height and makes number one hay. The Orchard Grass is more inclined to be *bunchy*, but it is a rank grower, and mixed with the Oat Grass adds materially to the meadow. All these grasses were introduced here by Dr. R. C. Kedzie, professor of chemistry in the Agricultural College, while he had charge of the station, and no grass since introduced has proven of equal value.

But far beyond all of these, for both forage and manurial value, is spurry —a plant also introduced by Dr. Kedzie, who had known something of its value in Germany and other parts of the old world. He imported seed the first year of the station's life, and it has proved of so great value that its use has been continued by his successor, as Director of the station. On the lightest soil it has given a uniform, even growth, and on a little better soil has yielded a ton and a half of cured forage which was greedily eaten by horses, cattle and sheep in preference to the finest clover or timothy hay, while as pasturage it has proven most valuable for milch cows and for sheep. Its quick growth, maturing in 60 days with favorable showers, makes it very desirable, as it can be grown and plowed under for manure for other crops the same year, while it stands drouth better than any of the grasses, and I believe it to be fully equal to a full crop of clover which would take two years to mature. The introduction of this plant by Prof. Kedzie will alone be of more benefit to Michigan in reclaiming the plains or Jack Pine lands than the entire cost of the station to this time.

I could "sing its praises" all day, but the above statements will give you an idea of my opinion, and when we meet I'll tell the rest.

Very respectfully,

O. PALMER.

Specimens of spurry were received from Dr. Palmer the first of September for analysis, which were a foot high. The climatic conditions under which it was grown are briefly told in the following extract from the *Avalanche* of September 7, 1893, published at Grayling.

RAINFALL.

One can hardly imagine the extent of the drouth in this vicinity without an exact knowledge of the amount of rainfall, which is given below, as recorded by the observer for the government: April, .92 inches; May, 1.45; June, .91; July, 2.07; August, .95; total, 6.30 inches. Besides the lack of rain, remember that it froze 26 nights in April, and eight during the first half of May, with very high winds for both months, which sucked the little moisture there was from the surface, and the only wonder is that there is any vegetable life left, yet corn is good and potatoes a fair crop, grain and grass suffering most from the abnormal condition.

Under such conditions of cold, drouth, and high winds, that a plant should produce on a light soil and in less than four months a forage crop one foot high, shows a vigor of growth and a power to withstand adverse influences quite remarkable.

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This spurry had matured a good crop of seeds which still remained in the boll. In the analysis to determine its food value it was considered fairest to take the entire plant, the seed with the stalks. A parcel was selected for this purpose, the roots cut away and the balance of the plant cut fine, dried and ground to fine powder for analysis. In this way the natural proportion of seeds and stalks was preserved in the ground product. Analysis gave the following results:

ANALYSIS OF SPURRY.

	Per cent.
Moisture	5.39
Crude ash	9.62
Ether extract, fat, etc.	5.76
Crude fibre	57.10
N-free extract, starch, etc.	8.57
Crude protein	13.56
	100.00

The crude protein contains of albuminoids 10.19 per cent and amide compounds 3.37 per cent. It may be that a dry season has secured a condensation of the most highly developed food materials, but the amount of crude protein in the entire plant—about on a par with the leading grains used for stock feeding—explains why it is greedily "eaten by horses, cattle and sheep in preference to the finest clover or timothy hay, while as pasturage it has proven most valuable for milch cows and sheep." The large amount of albuminoides required by sheep to produce the growth of wool suggests the great value of spurry in sheep husbandry.

The report comes from Newaygo and vicinity that the spurry has proved a great disappointment, the crop not growing according to expectations. My information is too limited to afford an explanation, but it is probable that the seed was sown too early and the young plants were killed by spring frosts, as the young plant is very tender to frost. It should be sown after the time of severe spring frosts.

LATHYRUS SILVESTRIS: FLAT PEA.

The flat pea was introduced into Michigan by the former Director of Experiment Station. The history of the plant and of its introduction was given in Bulletin 91 and need not be repeated.

This member of the Vetch family gives promise of extraordinary value as a forage plant. It developes a large strong root, and the nitrogen-assimilating tubercles are very large and numerous, in excess of any plant known to me. The roots penetrate very deeply in porous soils and it promises to be a plant capable of withstanding drouth when once well established. The seed is very slow to germinate and as the plant seems to be little affected by the frost it is possible that very late fall sowing may be the best way to get the plant started.

Dr. Palmer at Grayling writes that the "Lathyrus has withstood the drouth and made fine root growth but small top. It is entirely without manure except a light dressing of leached ashes and not much can be expected."

On the College experimental grounds this year the two year old plants have made a very large growth, the stalks being three feet long on July 13.

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A selected and measured square rod was cut July 12 and the green mass weighed, yielding at the rate of 16 tons per acre; dried and thoroughly cured it made 4 tons per acre of hay. This is not the most satisfactory way of determining the hay making capacity of a crop but it is submitted for what it is worth.

Some of the Lathyrus was cut on July 4 at which time it was in full bloom. The sample was analyzed and the results are here submitted. The analysis was conducted according to the "official method" and was carried on in duplicate giving concordant results, and the analysis has since been repeated. The results of analysis are surprising but no source of error is apparent.

ANALYSIS OF LATHYRUS SILVESTRIS.

	Per cent.
Moisture	7.99
Crude ash	8.32
Ether extract, fat, etc.	2.08
Crude fibre, woody matter	26.70
N-free extract, starch, sugar, etc.	27.74
Crude protein	27.17
	100.00

Of the crude protein the albuminoids constitute 14.36 per cent while the amide compounds form 12.81 per cent.

Analysis of a sample cut July 13 gives 25 per cent of crude protein.

If we fix our attention only upon the true albuminoids, showing more than 14 per cent in the air dry hay, we recognize the remarkable feeding qualities of this remarkable hay.

Inquiry has been made for seeds of the Lathyrus silvestris. The College has none for sale. A letter from J. M. Thorburn & Co., No. 15 John St., New York informs me that they will furnish imported seed for $2.25 a pound.

PEPPERMINT HAY.

In the southern part of our State large crops of peppermint are raised for making peppermint oil. The residue after the oil is distilled is dried and makes "mint hay," which is readily consumed by stock. While it will not make any large part of the hay crop of our State, its chemical composition may be of some interest. Mr. C. C. Pashby, a student from St. Joseph county, brought a sample of mint hay to the college for analysis, which gives the following results:

ANALYSIS OF MINT HAY.

	Per cent.
Moisture	11.40
Crude ash	6.04
Ether extract—fat, etc.	1.80
Crude fibre—woody matter	35.47
N-free extract—starch, sugar, etc.	36.73
Crude protein	9.56
	100.00

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The crude protein contains 8.12% of albuminoids and 1.44% amide compounds.

III. ADULTERATION OF GROUND FEED.

Complaints came to this laboratory from teamsters and draymen, that the chops or ground feed did not keep their horses in as good condition for work as formerly, and the chemical department was asked to find out the cause. Some of the ground feed was examined and appeared to be very rich in oats because of the abundance of the oat hulls in the chops. Equal measures of oats and corn were ground together to make the favorite mixture, and when this was compared with commercial chops, it seemed deficient in the oat element, the oat hulls being more abundant in the commercial article. In reality the chops had much less oats, the apparent richness in oats being the result of grinding a large amount of *oat hulls* with corn. Oat hulls accumulate in large quantities at the mills where oat meal, rolled oats, etc., are prepared, the real grain being separated as oat meal, etc., and the chaffy and nearly worthless hulls become an incumbrance until the happy thought occurred to some feed-mixer to grind them up with corn and make the popular "oats and corn chops."

To obtain more definite information on this subject, I wrote to a leading commission house for grain and feed, and obtained the following answer:

"DEAR DOCTOR:—

"Received your favor of 14th inst. and hasten to reply. Sorry to learn that you are on the track of millers who are using oat hulls and corn hulls (or corn bran as we term it), for the road is a broad one, and you will have a large territory to cover, and plenty of work to do if you catch all the rascals, as we all (or nearly all) use them. I send you a sample of oat hulls, such as I have used and as nearly all feed mills in the country do use; also sample of corn bran and a small sample of gluten feed. These are mixed with corn, screenings, barley, malt-sprouts and various other products that can be used and mixed in grinding to make chops. Also send you a sample of chopped feed as being sold here. Prices of hulls vary according to demand of feed, from $1.75 per ton to $8.00 per ton, F. O. B. shipping points, with various rates to New York and other points. Corn bran is worth $18.00 per ton at present, Boston points. Have bought it from $5.00 to $6.00 per ton less during the summer.

"No use to give names of millers as nearly every feed mill in the country is in the habit of using them or other cheap articles for grinding. Don't know as you could now call it a fraud, as it is generally known that such stock is used, and purchasers buying cheap grades of feed know what it is made from as the price gives it away.

"Any further information required on your part will be gladly furnished if possible, but remember that I am getting bread and butter out of oat hulls."

The guarantee of the quality of the feed from the price of the retailer will hardly satisfy the teamster, still less the team. If the horse only had a vote on this question!

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ANALYSIS OF ADULTERANTS.

The oat hulls and corn bran have been analyzed and the results of analysis given. For comparison the analysis of oat straw is placed side by side with oat hulls:

	Oat hulls.	Oat straw.	Corn bran.
Moisture	6.12	14.30	7.70
Ash	4.37	4.40	1.55
Fat	.54	2.00	10.65
Crude fibre	35.87	39.70	14.34
Carbhydrates	51.73	35.60	57.64
Crude protein	1.37	4.00	8.12

The composition of oat straw is the average of a number of analyses, taken from Armsby's Cattle Feeding. From this table it is seen that the oat hulls, with the exception of carbhydrates (starch, gum, etc.), is of *less value than oat straw*, having only about one-quarter of the fat and one-third of the protein or albuminous materials. On the other hand oat meal contains more than 17 per cent of protein, 6 per cent of fat, and 64 per cent of carbhydrates. The meal contains all that is of material value, and the chops where the whole of the oats is the oat hulls is poor fodder for working horses.

I have no remedy to propose for excluding such chops from the market. The best remedy is an enlightened public opinion, and the best cure for a fraud is to show that it is a fraud. Specimens of these adulterants are kept at the chemical laboratory and can be seen by any one interested in this subject.

GLUTEN FEED.

Another material which may become important in forming a food ration for stock is "*gluten feed*," the albuminous residue of corn in making starch. This is not the "gluten meal" so widely exploited in this State last spring by an agent of the Buffalo works. "Gluten feed" is too rich to feed alone, but would make a valuable addition to fodders too poor in fat and protein.

ANALYSIS OF GLUTEN FEED.

	Per cent.
Moisture	7.12
Ash	.85
Fat	6.45
Crude fibre	1.45
Carbhydrates	47.67
Crude protein	36.37
	100.

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Almost the entire amount of crude protein is in the form of albuminoid —36 per cent—while only .37 of one per cent is in form of amide compounds. The great value of gluten feed as an ingredient of stock feed is evident from an inspection of the above table.

IV. MINERAL RESIDUES IN SPRAYED FRUIT.

The practice of spraying fruits with certain mineral compounds to destroy insects and fungi has called out discussion in regard to the ripened fruit after such spraying, and its fitness for food. The subject has awakened an earnest discussion and many wild statements have been made on both sides of the subject. The first condition for intelligent discussion of any subject is to know the facts in the case.

The Horticultural department in 1892 and again in 1893 sent to the Chemical department specimens of fruit for analysis which had been sprayed during the season of growth, with a careful statement of the composition of the mixture used in spraying, the quantity used and the dates of application.

Two kinds of spraying mixtures were used. No. 1 consisted of 1 lb London purple in 200 gallons of water; and 6 lbs of $CuSO_4$, $5H_2O$ (crystallized sulphate of copper) and 4 lbs of lime in 32 gallons of water, the spraying mixture (unless otherwise stated) consisting of equal measures of the London purple and the Bordeaux compound. The No. 2 spraying mixture differed only in the use of 2 lbs of the copper salt and 1½ lbs of lime for 32 gallons of water with an equal measure of the London purple mixture.

In stating the results of analysis the calculation is made on the basis of one pound avoirdupois of fruit, and the metals found in a pound stated in grains; the "arsenic" as white arsenic (As_2O_3) and the "copper salt" as blue vitriol ($CuSO_4$, $5H_2O$).

RESULTS IN 1892.

Strawberries No. 1. Sprayed with No. 1 mixture June 18 and 23, one-half gallon on one rod of row. Picked June 24. Fruit excessively sprayed, the berries nearly covered with the mixture.

Arsenic found	.044 grains
Copper salt	4.87 "

Strawberries No. 2. Sprayed June 18 and 23 with No. 2 mixture, one-half gallon to rod of row. Picked June 24. Excessively sprayed.

Arsenic found	.0298 grains
Copper salt	1.821 "

Red Cherries No. 1. Sprayed June 18 and 30 with No. 1 mixture, one gallon to a tree. Picked July 6.

Arsenic found	.0882 grains
Copper salt	.390 "

Red Cherries No. 2. Sprayed June 18 and 30 with No. 2 mixture, one gallon to a tree. Picked July 6.

Arsenic found	.025 grains
Copper salt	.252 "

White Cherries. Sprayed June 30 with No. 1 mixture, one gallon to a tree. Picked July 1.

Arsenic found	.121 grains
Copper salt not estimated.	

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Red Currants. Sprayed with London purple solution May 25, June 7, 18 and 30, one gallon to one rod of the row the first and second times and three-fourths of a gallon the third and fourth times. Picked July 8.

Arsenic found	.0503 grains

Raspberries. Sprayed with No. 2 mixture June 6 and 28 and July 8. Picked July 20.

Arsenic found	.0098 grains
Copper salt	.028 "

Gooseberries No. 1. Sprayed with No. 1 mixture June 18 and 29, July 8 and 22, one-half gallon to a row two rods long. Picked August 2. The fruit was first washed with 10 per cent Hydrochloric acid to dissolve off the visible remains of spraying and the acid washings and washed fruit separately analyzed.

Arsenic in acid washings	.0186 grains
Copper salt	.463 "
Washed fruit:	
Arsenic found	.0047 "
Copper salt	.138 "
Total residue found on and within the fruit:	
Arsenic	.0233 "
Copper salt	.601 "

Gooseberries No. 2. Sprayed June 18 and 29, July 8 and 22 with mixture No. I, ½ gallon to two rods of row. Picked August 2.

Fruit washed with acid the same as the preceding specimen.

Arsenic found in acid washings	.0207 grains
Copper salt	.212 "
Washed fruit:	
Arsenic found	.0165 grains
Copper salt	.150 "
Total residue found on and within the fruit:	
Arsenic	.0372 grains
Copper salt	.362 "

Pears. Sprayed June 15, July 7 and 21, and August 7 with mixture No. I. Picked September 6.

Arsenic found	.0088 grains
Copper salt	.0738 "

RESULTS IN 1893.

In the experiments with tree-fruits this year the Bordeaux mixture of 2 lbs copper salt and 2 lbs lime to 32 gallons of water was used for spraying the fruits on the tree. The London purple was omitted.

Pears were sprayed May 15, June 12, and July 10. One pound of the fruit gave the equivalent of .100 grains of copper salt.

Russian cherries were sprayed with Bordeaux mixture May 14, June 10 and 18 and on July 15 with modified eau celeste.

One pound of fruit contained .147 grains of copper salt.

Plums treated in the same way as Russian cherries, and at the same time, gave .2 grain of copper salt to a pound of fruit.

In these experiments extending through two years, the minerals used in spraying the fruits were found in appreciable quantities in every instance, though the amount was small in all cases except when the spraying had been purposely excessive.

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The inquiry naturally arises whether these poisons merely adhere to the surface or penetrate the substance of the fruit? The results with gooseberries seem to show that they penetrate the body of the fruit to a limited extent. A test of this question has been made with some of the sprayed pears. A pound of the pears was selected, the skin carefully pared off and burned by itself, and the body of the pear burned to ashes by itself and each ash separately analyzed. The pear pealings from 1 pound of pears gave .106 grains of copper salt, and the flesh gave .071 grains, showing that while most of the copper salt adheres to the surface, a portion finds way into the body of the fruits.

The copper salts adhere to vegetable surfaces more persistently than is commonly supposed. A student in chemical analysis (W. F. Wight), during the first week in May, 1893, made some investigations on this subject. The outside bark of trees that had been sprayed with Bordeaux mixture was gathered, burned to ash, which was dissolved in nitric acid and the copper plated out on a platinum dish and weighed. The results are calculated for 100 square inches of bark surface. The bark of a tree that was sprayed April 18, 1893, gave .124 grains of metallic copper. The bark of a tree more recently sprayed, and on which the spray was still visible, gave .28 grains of copper. The bark of an apple tree sprayed about one year before gave .05 grains, and the bark of a plum tree sprayed about June 1, 1892, gave .044 grains of copper.

The suggestion has been made that an opinion in regard to the safety in the use of such sprayed fruits as food would not be out of place. The condition where the poisons are applied directly to the fruit a short time before ripening is quite different from that where the poison is applied to one part of the plant while an entirely different part is used for food, such as the application of Paris green to potato vines to kill the Colorado beetle. So also the spraying of the young apples with Paris green soon after the blossoms have separated in order to destroy the larva of the coddling moth is quite different from spraying the developed and ripening fruit. The persistence with which such poisons adhere to the bark and other surfaces as shown in preceding experiments is quite significant.

The use of poisons in horticulture in my opinion is largely in excess of the amount required for a fungicide. One-half or even one-third of the amount usually employed would probably give as good results.

In the spraying of some fruits, such as strawberries in 1892, the amount was purposely used in large excess. In one case nearly five grains of blue vitriol were recovered from one pound of fruit—a dose no sensible person would want to take in his food. Yet even that dose would not probably be fatal, though it might cause vomiting. Any of the doses of arsenic or of copper found in a pound of these fruits might be swallowed without endangering life by such single dose. It is the repeated doses, day by day, of such poisons that might produce slow poisoning and the gradual undermining of the health without obvious cause. It is safe to refuse all fruits which have been sprayed with these poisons (especially arsenic) during the period of ripening.

For a large part of the analytical work which forms the basis of this bulletin I am indebted to my assistants, W. L. Rossman and H. E. Harrison. I am fortunate in having such able and faithful helpers.

AGRICULTURAL COLLEGE,
September, 1893.

R. C. KEDZIE.

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CELERY INSECTS.

Bulletin No. 102.—Entomological Department.

Michigan is peculiarly a celery state. It no doubt has enough swamp lands, of the peculiar muck soil, so requisite to the best success in celery culture, to supply the whole country, and certainly will make use of them largely for this appetizing plant in the near future. Every year brings an increased acreage. When celery was first introduced and raised only in limited areas, no insect attacks were ever reported, and probably none occurred, as an introduced plant is seldom attacked for several years. As several species acquired a liking for it, occasional reports of injury would be received. The past two or three years, the species that attack celery have so greatly increased in numbers and severity that the calls demanded a more extended knowledge which would assist both professional and amateur celery growers to keep these little depredators in check by means of the best remedies that could be suggested. So far as can be ascertained, only two species have been reported in economic literature as celery insects.

But little celery is grown at the college, and what has been learned has been largely by frequent visits to the extensive fields at Kalamazoo, Tecumseh, and Jackson, and through correspondence with some of the most intelligent growers at these places. More might have been learned could the fields and myself have been in closer proximity, but the most destructive species are briefly described, illustrated, and remedies given. Many are spoken of that are not numerous at present but may be in the seasons following.

I wish to express my thanks to the members of the Board and the Directors of the station for their generosity and assistance in making this bulletin what it is, and to Mr. Russell of Tecumseh, and Mr. Wilson of Kalamazoo, and the many other celery growers at the various places visited, for their ever ready assistance in the field work. I am also very grateful to Mr. VanDuzee, Prof. Fernald, Prof. Osborn, Prof. Williams, the department at Washington, D. C., Profs. Cook and Wheeler of this college, and others who have so kindly assisted me in determining the various material gathered.

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LOCUSTS AND GRASSHOPPERS.*

Owing to favorable seasons last year and this for grasshoppers and locusts, they have been very numerous and made their work felt on various plants—celery being one of the number. Those celery fields that have been surrounded mostly by high meadows, grain fields, forest or pasture lands, have suffered the most severely. It is on the drier, more sandy land that they are the most numerous early in the season, and then, as vegetation in these places becomes dry and partly dead, they avail themselves of the fresh and green fields of celery in the low lands. They will never be found on the low lands in numbers except in dry weather when they are driven from the uplands by a scarcity of food. The eggs are laid on sandy knolls or the mellower parts of the uplands, and here the young hatch and attain considerable of their growth before they travel any distance.

If the fields where the hoppers breed could be plowed and thoroughly rolled in the fall, and kept under cultivation the following season, the hoppers would probably be considerably reduced in numbers. The roller is especially important as it is found that rolling crushes so many of the frail egg cases.

THE MOST DESTRUCTIVE SPECIES.

Fig. 1, The red-legged locust, *Melanoplus femur-rubrum*. (after Riley.)

Fig. 2. The two-stripped locust, *Melanoplus femoratus*. (after Riley.)

The species most frequently found and found in the greatest numbers was the common red-legged locust, *Melanoplus femur-rubrum* (Fig. 1). While no special study of the species on celery was made, it was evident that those common in meadow and pasture lands were proportionately common in celery fields. They stripped the celery of its leaves along the border as readily as that of any forage plant. Some of the species besides the red-legged locust that were common are the two-striped locust, *Melanoplus femoratus* (Fig. 2), and *Dissosteria carolina*. Of the common meadow grasshoppers, *Orchelimum vulgare*, *Xiphidiumfasciatum* and *X. strictum*, and the katydid, *Scudderia furculata* (?) were plentiful.

REMEDIES.

A very good preventive, in one instance at least, that came under my observation while in one of the fields, was to leave a strip of land about

* The term *locust* is applied in its more restricted sense to the brown hoppers with short horn-like antennæ, or feelers, and *grasshopper*, to the green hoppers with long thread-like antennæ, and will be so used in this bulletin.

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four rods wide without plant growth. The instance cited was a strip used in the spring for a plant bed. It was along the end of a field next to a pasture field. The plants had all been taken up and transplanted in other parts of the field and the strip left idle until used for a late crop of celery. The locusts were plentiful along the border, but only a few wandered in far enough to reach the celery, while the other borders were suffering from locust invasions. The disuse of so large a strip of land makes this method of prevention rather expensive unless the surrounding land is of little value. The surrounding of the fields with ditches partly filled with water, although reported as effectual, is also quite an expensive outlay.

At my suggestion, Mr. Slater of Tipton tried sweetened bran with Paris green added, as suggested on page 4 in bulletin 98. He reports that he had no trouble in getting the hoppers to eat it, but was unable to tell whether it killed them or not. From some experiments conducted by myself there seems to be no doubt but that they are killed and quite quickly. The locusts were placed in three lots of which one was fed on molasses and bran with enough Paris green added to give it a green tinge, another the same with strychnine instead and the third without poison. Inside of twenty-four hours those fed on the Paris green were all dead. At the same time only one of those given strychnine was dead, and all were lively and active in the unpoisoned case. It is quite probable that Paris green used in this way will prove very helpful in keeping the number of locusts diminished, but care must be taken that it is not used where fowls or stock can get at it.

What at present seems to be the most effectual means of thinning the numbers is a modification of the "hopper dozer" spoken of and illustrated in bulletin 98. This modification was devised and used by Mr. C. H. Hardy of Tipton and, from his trial of various remedies through the season, he feels that this method is superior to all others. He bought large flocks of turkeys and chickens hoping they would keep the locusts in check, but they trampled the plants and ate the plume of the older ones and did not diminish the number of locusts as much in a day as two men would in a few hours with his hopper collector. The accompanying cut shows

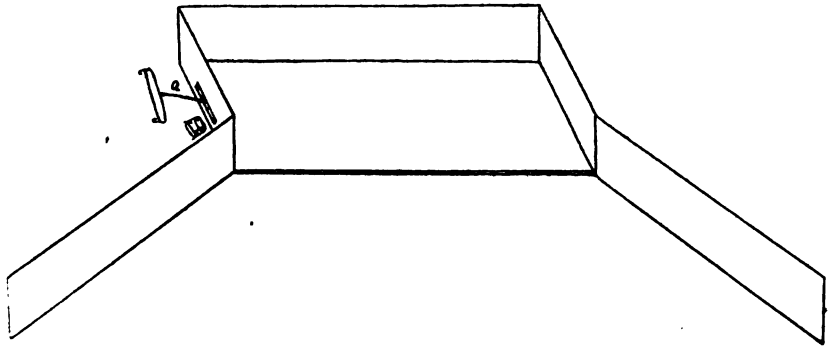

FIG. 3.—Modification of the "hopper dozer" as used by Mr. Hardy. *a*. Whiffletree attachment—(original).

the outline plan. The pan is made of sheet iron and is about 12 or 15 feet long by 4 to 6 wide. Then with a high fender on three sides and projecting wings from these and a whiffletree attachment at one end as at *a*, the mechanism is complete. The horse draws the pan to where it is to be set

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on the grass at the border of the celery, then two men go into the celery and drive the locusts toward the pan. The two wings aid in crowding them into the center, and soon a large number of the hoppers are on the tar which has been previously coated over the inside of the pan. The collector is then driven up another space and the same operation repeated. Mr. Hardy used an old sugar pan with one side cut off and wings added. It is easier to collect the hoppers before their wings are fully developed, or in the cooler part of the day when they do not fly so readily. The regular hopper dozer is not practical in the celery fields as it must be raised so high to run over the plants without injuring them that the hoppers mostly go under the pan.

THE TRUE BUGS—ORDER HEMIPTERA.

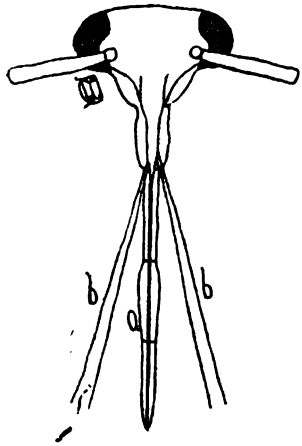

Fig. 4.—Head of the tarnished plant bug, showing the jointed beak, or rostrum, *a*, and the four needle-like mouth parts, *b*, used in piercing plants—(original).

This order of insects furnishes nearly one-half of the celery pests, and several of the most injurious ones that we have. They do not bite or chew, but puncture the plant and draw the sap through the puncture. They are all characterized by having a beak. In the accompanying cut, the head and beak of the tarnished plant bug are shown. The four needle-like parts work together in the groove inside the beak, and, after they have pierced the plant, the sap is sucked up through this groove into the stomach. The beak does not enter the plant, but only presses against it. In the very young stage of this tarnished plant bug, the whole operation showed more plainly than any before observed. The piercing needles entered the plant as rapidly and apparently as easily as one could push a pin into a cushion. As the needles passed on through the stalk, the jointed beak became telescoped till it was all in two joints and scarcely half the length it was at first. It is thought by many that these bugs injure the plants by secreting a poison when the sap is drawn. It is quite probable this may be so for the purpose of increasing the flow of sap. We all know of the mosquito poisoning for a similar purpose the puncture it makes.

LEAF HOPPERS.

All through the season, leaf hoppers were common on the celery. Early in the season they were especially abundant, usually flying ahead of one like a swarm of flies, as he passed through the field. When the plants are small, these leaf hoppers do a great deal of injury by sucking the sap from the plant through the thousands of little punctures that they make with their pointed, beak-like mouth parts (see 4a, plate I). While the plants, for the first few weeks after transplanting, are having their hardest struggle for existence, the little leaf hopper's work is the most destructive. This season many fields of celery were retarded in growth at this period. This is a part of the season when the celery grower can the least afford to allow any interruption in the growth of his plants.

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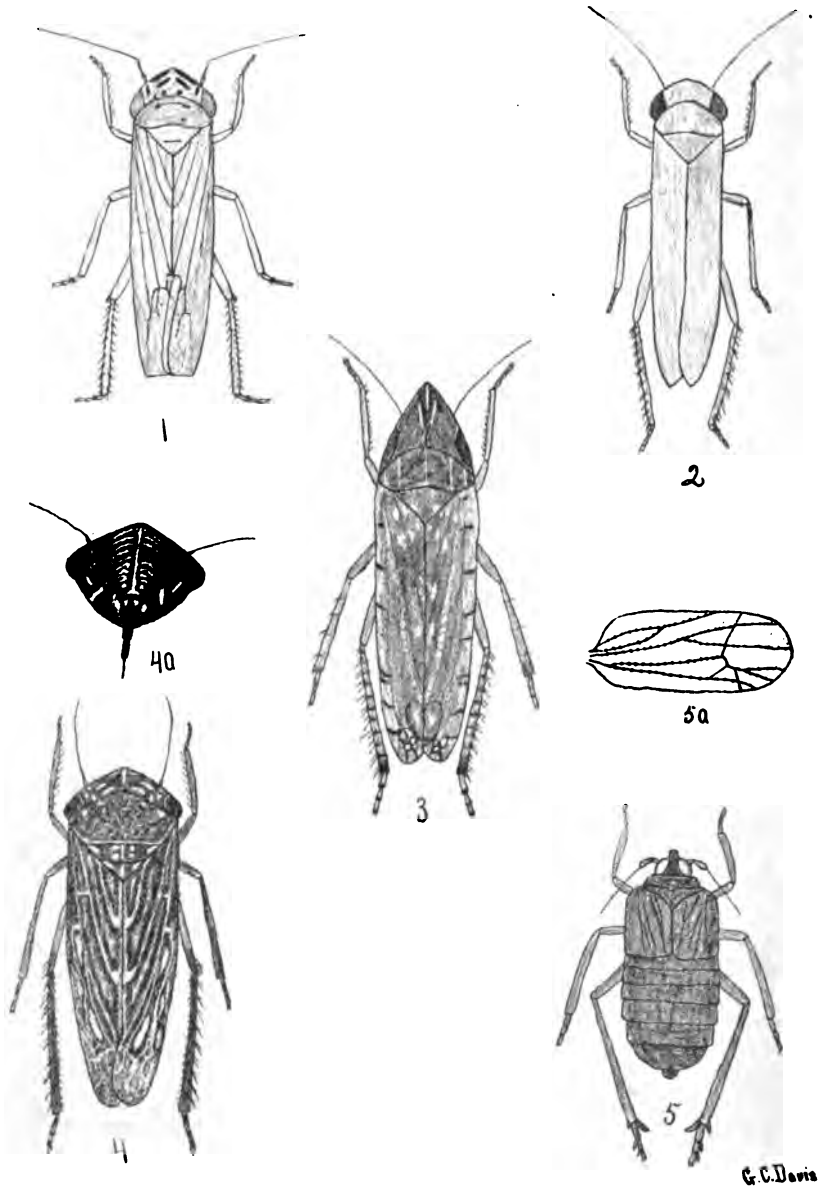

PLATE I.—Fig. 1, *Cicadula 4-lineata*; 2, *Empoasca mali*; 3, *Platymetopius acutus*; 4, *Athysanus instabilis* n. sp.; *a*, front view of the head showing cypleus, lora, cheeks and front; 5, *Megamelus piceus* n. sp.; *a*, complete wing of macropterous form. All drawn ten times the natural size.

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SPECIES THAT WERE MOST NUMEROUS.

1. *Cicadula 4-lineata* Forbes (Fig. 1 of plate I) was the most common species everywhere. At the college and where the muck had considerable clay in it, they could be taken by the hundred at almost any time in the season. The species is greenish brown, with yellow scutellum, and head spotted as shown in the figure.

2. *Empoasca mali* Le B. (Fig. 2 of plate I). This is a pretty little yellow species with transparent greenish wing covers and green legs. It was very common through the season after July. At Kalamazoo many were found down in near the heart on blanching celery. It is probable that they help spot the white stalks. They breed on the plants.

3. *Platymetopius acutus* Say (Fig. 3 of plate I). was common the latter part of the season. The young were found on the plants early this fall. The species probably does little harm as it prefers to be high up on the leaves instead of on the stems. To the naked eye it is a dark brown and can be easily told by the acute projection of the head.

4. *Athysanus instabilis** n. sp., Van Duzee (Fig. 4 and 4*a* of plate I).

Form of *Deltocephalus inimicus* Say. Black, dotted and marked with fulvous as follows: hind edge of the vertex, a dot, sometimes wanting, touching this either side of the middle, another near each eye, two marks on the disc, a line before each of these, an angular mark at apex including a short longitudinal dash, a dot on the temples, six or eight arcs and the central line on the front, the latter expanded on the clypeal suture, two dots on the base of the clypeus, another on each lora, a spot on the cheeks and their slender outer edge, the irrorations of the pronotum and a few large spots on its anterior edge, six spots on the scutellum—four marginal and two discal—and its median line, knees, a transverse band on the femora and the slender hind edge of the abdominal segments. Posterior legs pale, more or less clouded with fuscous, with the inner face of the flattened tibia black. Elytra pale, slightly clouded at apex, the areoles broadly margined with fuscous, nervures whitish. Last ventral segment of the female long, feebly arquated either side of the middle, with the lateral angles prominent. Valve of the male short, plates triangular subacute. Length 4–4½ m. m.

Quite common at the college through August and September. Mr. Van Duzee has the specimens of the same species from Colorado also.

5. *Megamelus piceus* n. sp., Van Duzee (Fig. 5 and 5*a* plate I).

Piceous-black; base of the vertex, keels and narrow hind edge of the pronotum, disc of the mesonotum, or at least its carinæ, disc of the tergum, especially towards its base and apex, and the edge of the dorsal keel; the genital segments and sometimes the base of the venter, brownish yellow. Face pale shaded to brown above, clypeus deep black. Antennæ, rostrum, tylus, and legs pale, soiled yellow, the later lineate with brown. Elytra reaching to the second abdominal segment in the branchypterous form, with the apex truncated, piceous-brown, or even black, with the apical edge white more or less broadly interrupted with black at the middle; nervures strong, granulated. In the macropterous form the elytra extend considerably beyond the tip of the abdomen about as in *Liburina pellucida*; they are smoky with pale granulated nervures, the exterior and interior of which are forked at about three-fourths their length. Pygafers of the male cylindrical, on their ventral aspect cut out for about one-half their length and carrying on the broad base of this incisure a broad and short projection extended into a short conical divergent tooth at each angle, beyond this are the incurved spine-like stylets included between the long slender ventral projections of the plates. Length, 2½ to 3 m. m.

New York and Michigan. Described from many examples of both sexes taken in western New York on grass in low swampy meadows in August and September, and one female taken on celery at Kalamazoo, Mich., August 26, 1893, by Mr. G. C. Davis.

In this species the vertex is shorter and broader, the pronotum shorter and the meso-

* This and the following species were found to be new to science and Mr. E. P. Van Duzee, a specialist on Jassidæ, to whom they were sent, has kindly consented to describe them. His same descriptions will also appear in the Canadian Entomologist.

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notum longer with more divergent carinæ than in *M. notulus*. The yellowish markings above vary much in extent, some specimens being almost entirely of a dull piceous-black while some are pitchy brown with the pale markings much extended. The characters of the head, the pale face and the black vertex and clypeus seem quite constant as does also the color of the tylus, rostrum, legs and elytra.

Of the other species *Phelpsinus irroratus* Say and *Agallia sanguineolenta* were quite often taken; *Tettigonia noveboracensis*, *Thamnotettix clitellaria* *Deltocephalus melsheimeri* Fitch and *D. inimicus* Say, occasionally taken. No extensive collecting was done in getting this material. To secure specimens of those most common on celery rather than a complete list was the object.

REMEDY.

Owing to the fact that leaf hoppers do not feed by chewing the plant, but live on sap taken from the inside of the stem or leaf, most of our insecticides are of little avail. This being the condition and the hoppers so injurious to the young plants, another method was devised that has

FIG. 5.—The hopperette used in collecting leaf hoppers, flea beetles and many of the celery bugs. *a*, string—(original).

succeeded even better than my first anticipation had predicted. It is by means of a small tarred pan attached to a hand wheel hoe as in Fig. 5. The pan is made of sheet iron. The bottom is 16x20 inches with a notch

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six inches deep by four wide cut in the center of the front edge. On the two sides and back is an upright sheet about four inches high to prevent the leaf hoppers jumping over. The edges of the front side and notch are rolled up merely sufficiently to prevent the tar on the bottom from running off; one-eighth of an inch is ample. The hopperette, as we will designate this collecting pan, is attached to the wheel hoe by two strips of strap iron fastened under the pan as a support and at the other end bolted to the frame of the hoe or fastened in any way that will make it solid. The shaping of these braces and the lowering of the pan depends entirely upon the make of carriage used. The one used in my own experiments was a two wheeled hoe sold by D. M. Ferry & Co. under the title "Planet Jr." With this machine the pan was lowered five inches below the axle, which brought it very close to the ground and still kept it level. When placed entirely in front the pan can be raised or lowered considerably to conform to the uneven surfaces on the ground. The notch cut in the bottom is a great aid as it permits the plant to be nearly surrounded before it is disturbed and all insects are caught that jump to the sides as well as back. Another feature that added considerably to the efficiency of the hopperette was a strong twine string stretched across the notch about four inches in from the edge, as at *a*. This not only protects the plants from the sharp edges, but causes the hoppers to leap at the right time. If the holes punched for the string cut it, eyelets may be used or a wire about the same size may be used.

COST OF HOPPERETTE.

The first cost for collecting leaf hoppers in this way is very slight and it takes comparatively little time in collecting, as a man can pass over a considerable area in a day. The pan made of sheet iron cost $1.25. There is no patent on this or the collector spoken of under locusts and they may be made by any tinner. The coal tar used in coating the pan is very cheap. Enough of the tar should be kept in the pan to occasionally run over the bottom and recoat it, and by this means cover over refuse material and insects that have accumulated. Those who may wish to purchase a "Planet Jr." for use in the celery fields and for leaf hoppers too will find it listed in D. M. Ferry & Co's catalogue at $4.00. With an outlay of not over $6.00, and a few hours' work, many times that amount will be saved in the celery crop where the little leaf hoppers are at all thick. One may not realize how many there are of them till he stirs the plants and watches the number hop away. In my first trial of the hopperette, the hoppers were not as common as a week or two earlier, but on a row five rods long at least two hundred were caught.

THE TARNISHED PLANT BUG (*Lygus pratensis Linn*).

ORDER HEMIPTERA. FAMILY CAPSIDÆ.

A brown bug that is the cause of the rusty, dead spots and streaks on celery known among growers as one form of "sun scald," but different from the disease known as leaf spot, which will be treated of later.

Although not found in such great numbers as some other pests, the tarnished plant bug is one of the worst with which the celery grower has yet had to contend. It goes directly to the tender stalks of the plant that are blanching and by means of its beak draws the sap from the stem, and

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leaves a large brown wilted spot which greatly mars the attractive appearance on the market and lowers the price accordingly. I do not remember of talking with a celery grower this season, who knew the real cause of these brown spots on celery. The most general belief was that it was caused by "sun scald," or perhaps bruised in blanching. This is not at all surprising as the bug is so shy and retiring, when one is near, that it is only by quiet and careful watching that it is seen feeding. Then, too, it

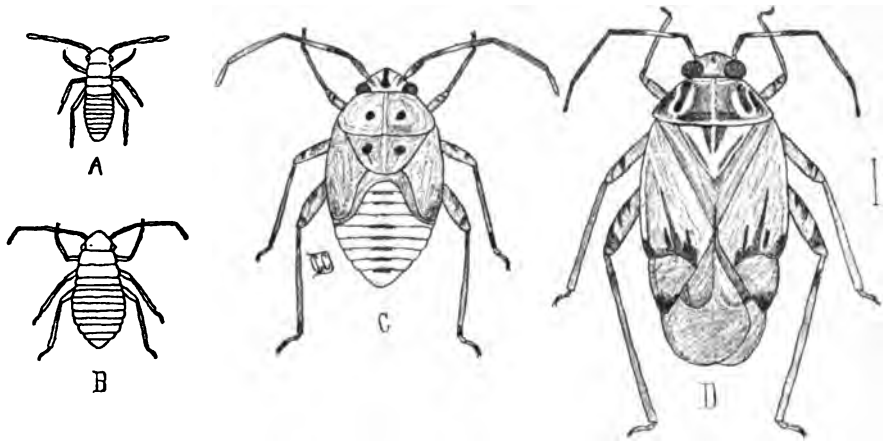

FIG. 6.—The tarnished plant bug, showing the various stages of growth. A, very young bug; B, second stage; C, the fourth stage; D, the matured, winged form. The line at the right shows the natural size —(original).

is almost always well in toward the center of the plant and is protected largely from view. Very often when disturbed, or even on the approach of possible danger, the mature form will take wing and fly away, and the younger ones not having wings will drop to the ground and seek protection there.

LITERATURE.

The tarnished plant bug is a native of nearly all parts of our country. For this reason, coupled with its general destructiveness, it has been made the subject of many articles. Nearly all are brief notices of injury done. The only really extensive or exhaustive article on the species is by Prof. Forbes in the 13th Illinois Entomological Report, 1883, pp. 115-135 (Ill.). All of the more important literature is referred to here. The work treats of the bug as a strawberry insect, causing the berries to shrivel by sucking the juice from them. Pyrethrum is the remedy recommended. In the following year, report 14, pp. 79-80, additions to the previous report are given in which Prof. Forbes describes the egg of the bug and records an experiment with pyrethrum not working as well as expected.

Several other authors have before and since written short accounts of it as a strawberry bug.

The earliest important article was by Dr. Harris in "Insects Injurious to Vegetation," pp. 199-203. Under the name of *Phytocoris lineolaris*, he treats of it as injurious to flowering plants and potato vines, and recommends simple but as inefficient remedies.

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THE DIFFERENT STAGES OF GROWTH.

As a usual thing it is only the larger winged form that we notice, the young forms remaining concealed in the denser part of the plant. The common name, tarnished plant bug, is a very appropriate one for the adult as it has a stained or tarnished appearance, though still retaining a polished surface. It is a very variable species in its markings, and has until recently been considered as several distinct species. The females, as in the figure, are quite a light brown with yellowish white markings; the males, a dark reddish brown with scarcely a light marking. Intermediate markings, ranging between the two extremes, may also be found. There are four distinct stages of growth between the egg and the mature form; the first, second and fourth of which are illustrated in the accompanying figure. The small line at the side shows the natural size. The first two stages are entirely wingless, and in color are a light green. They resemble the plant very closely, and this affords them a means of protection which they often make use of by keeping very quiet on the stalk of like color and so are easily overlooked. The next two stages begin to show evidences of the wings, quite small in the first but very distinct in the next. They are still green with a very few dark markings, but the color does not seem to be used much as a protection in these two stages.

THE LIFE HISTORY.

Early in the spring the first insects to make their appearance on early vegetation are the imagos (adults) of the tarnished plant bug. They have lived through the winter in this form, under boards, bunches of dead leaves, grass, rubbish, or anything that they can find which will give them shelter. They are very general feeders as will be readily seen in looking for them on the plants in one's immediate vicinity. They feed on all the common weeds as well as grass, clover, and plants raised for their flowers. The fruit, blossoms and foliage of the pear, apple, quince, strawberry and grape suffer alike from their piercing beaks. Our vegetables suffer in the same way. They not only feed on these plants but breed on them also. Early in the season the eggs, described by Prof. Forbes as minute, white, smooth, slender, oblong ova, are deposited on the plant. From these the young soon hatch. They are at first very slender for their size, but, as they grow older, the imbibing of so much sap tends to expand the body much faster than it lengthens. From the first part of June through the remainder of the season, all stages from the youngest up could be found on the celery though at times certain stages were more common than others. Before the cold autumn weather becomes severe, the adults are again in winter quarters.

BEST MEANS OF FIGHTING THE BUG.

A great many insecticides have been tested only to find them ineffectual and unsatisfactory. Owing to the bug sucking its food from the inside of the plant, no remedies affect it except those that kill by contact. Of these, the kerosene emulsion, so often recommended in our previous bulletins, is probably the best, but as the bugs are so shy and hide, or take flight so readily, a large per cent of them escape even with the most thorough work. It was noticed that in collecting leaf hoppers with the hopperette,

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quite a number of tarnished plant bugs were also collected and it seems probable that this is a quicker and cheaper means of fighting them than is any insecticide.

As prevention is better than cure in disease, so it is with this bug, and we must look largely to this means in keeping it in check. The relation between the number of bugs and the manner in which the celery fields and surrounding borders were kept, was very noticeable in every celery field visited this season. If long grass, weeds, loose sods, or boards were left scattered along the border or in the vicinity of the field, the bugs were sure to be there in greater numbers than where everything was kept picked up and cleaned up so that the bugs could find no protecting shelter in which to hibernate. This is the reason certain localities suffered so much more than others. Occasional exceptions in locality were seen, but where such occurred the bugs were scarce in proportion to the care used in keeping rubbish cleared from the fields.

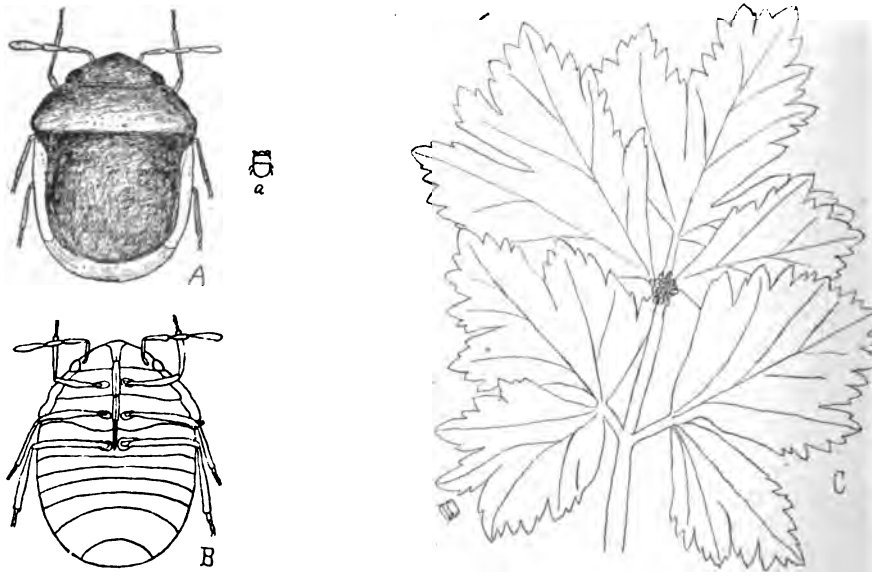
The loss produced by the bug is impossible to estimate as it is not a total loss of celery, but only a decrease in the market price. The loss in this way is a serious one as every celery grower who has a poor article to put on the market well knows; and when it can be avoided, at least the most of it, by a little care and tidiness, it is well that all such precaution be taken.

THE LITTLE NEGRO BUG (*Corimelaena pulicaria*, Germ).

ORDER HEMIPTERA. FAMILY CORIMELAENIDÆ.

The little black bug which appeared so suddenly and in such great numbers on celery this season. It kills the leaves and dwarfs the plant. By the remedies suggested it is thought it can be controlled.

Fig. 7.—The little negro bug. A, upper side much enlarged, *a*, natural size; B, under side of the same showing the beak; C, section of a leaf with bugs at work—(original).



No celery insect up to the present time has caused more alarm over the State than this species did the past season. It came so suddenly and in such great numbers at Tecumseh that for a time it appeared as

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though many fields would be cut to the ground in a few days. The attack was quite general all over the celery-growing portions of the State, but not as severe as at Tecumseh and vicinity. The fields at Jackson suffered slightly, and one field at Kalamazoo was quite badly injured. The bugs appeared on the college celery but did no harm.

On the 22d of July letters from Tecumseh and vicinity began coming in, asking for information and help. The following may be taken as a sample of those received.

"DEAR SIR—I mail you a box containing some bugs. Millions on millions have commenced work upon our celery, from twenty-five to fifty collecting about one leaf and in an hour or two it is gone. * * * They are doing great damage and if they last many days, will do many thousand dollars worth of damage. Please state if there is any remedy and how long they will last and what you know about their habits. Please answer at once.

Yours truly,
E. L. RUSSELL."

Several similar letters being received the same day made it imperative that something be done, and before Mr. Russell's reply reached him, I was in his field of bugs and celery.

METHOD OF ATTACK.

The attack was very sudden and severe and Mr. Russell's statement was found to be no exaggeration. They had not acquired possession of the entire field, but were extending their domain daily. The first thing that would be noticed in the attack upon a plant was a knot of little black bugs around the node where the three top leaflets met, and here they would suck the sap till the leaflets wilted and drooped, when they would go down to the next joint below and so repeat the operation till the leaf was drained of its sap; then they would pass to another leaf and attack that in the same way. They always went in bunches of usually from fifteen to thirty when feeding. With so many little beaks drawing the sap from the leaves, it is no wonder the destruction was so rapid and alarming.

The attack was almost invariably made on the highest leaves. When one of them was cut down to the denser part of the foliage, the leaf would be left and others reduced to the same level. When they came to the plume (central white leaves), it suffered the same and then the plant was spoiled for market. This habit of taking the highest leaves first is no doubt due to their love for heat and sunlight which they could not have when below the crowded central leaves. In looking over a field after the bugs have worked in it a few days, it has the appearance of having been clipped off about half way down and the dead leaves left just where they had been cut off. The plant would be in a much better condition after recovering from a clipping than from an attack of this kind, as the dead leaves are still attached, which in itself is harmful, and then they so completely cover the living part that it is almost entirely shaded.

In their attack the bugs showed a great preference for the older celery that had commenced to grow stalky and was nearly ready to blanch or was blanching. The younger celery where the leaves were spread out and the center exposed was injured comparatively little. Where the bug did work on such plants, they were found sometimes on some of the higher leaves as described before and sometimes in little groups around the heart stalks.

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THE EFFECT.

As the heart stalks of celery form the edible part of it, the bugs could not have attacked any other part of the plant where as little harm would be done as on the higher and older leaves. Then, too, the severest part of the attack did not last over three weeks. It was the attack of such countless numbers that made their work so severe. Most fields at Tecumseh suffered less than was at first feared, but where the bugs were abundant the loss to celery was considerable. Plants, that had suffered a severe attack, were retarded in their growth from two to three weeks, and when they appeared to have recovered, it was not with the same large perfect stalks, so characteristic of Tecumseh celery, but with a large number of little curling, gnarly stalks that would be of little or no market value. We might as well say that in such cases the crop was an entire loss.

NOT THE CHINCH BUG.

Fig. 8.—Chinch bug (*Blissus leucopterus*).

Owing to the sudden appearance of this little negro bug, a great many in the region thought it surely must be the chinch bug. Some were not convinced till specimens of the chinch bug were sent from Iowa and compared with the negro bug when they at once saw a great structural difference. Both have the odor peculiar to all similar bugs and have a beak for sucking, but are very different in most respects. The form, as will be seen in the two cuts, is entirely different, and the chinch bug is not shining black, but a dull, dusty brown with the terminal half of the wings membranous. There is little danger of a chinch bug invasion as far north in Michigan as the celery fields.

GLEANINGS FROM LITERATURE.

Before we attempt to suggest any remedies let us learn more about the little negro bug's habits, and what others have learned of it.

The earliest account of its destructive habits that was found is an article in the Canadian Farmer for August, 1867, where Rev. C. J. S. Bethune speaks of its attack on strawberry plants in Canada.

In the same year B. D. Walsh, in the Practical Entomologist, Vol. II, p. 119, reports it as swarming on raspberries in Missouri in such numbers as to render the berries worthless both from odor and taste.

Walsh and Riley, in the American Entomologist, report it as puncturing strawberries and causing the blossoms and fruit to wilt; also as attacking the cherry, quince and pear in the same way. The remedy suggested was cresylic soap, which has long since been superseded by better remedies.

Dr. Riley in his second Missouri Report (1870), gives a review of the plants attacked and reports it very common all over the state the year before.

In the Prairie Farmer, August 15, 1868, he reports a new growth of stems and leaves of grape vines injured by it.

In the U. S. Agricultural Report, 1884, p. 390, Mr. Webster reports breeding the bug on wheat.

Prof. Forbes in his Illinois Report for 1890, p. 51, reports it common in

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wheat and grass fields along with the chinch bug, and for this reason often considered injurious by farmers, but it seemed to feed only on weeds.

There are a few other minor references, but these give us something of an idea of its habits and the cultivated plants attacked. It always has been known best as a strawberry insect, because the oftenest found injuring that plant. The above references are all largely incidental, but with these and what has been learned of it on the celery this season, we are enabled to more closely determine its

LIFE HISTORY.

We owe thanks to Mr. Webster for assistance by his notes on the early stages of this bug, as it is single brooded and the first brood was mature when found on the celery. His record is: "Adults were observed copulating May 9, and were at once confined on wheat under glass, being fed on ripe strawberries. The females began to oviposit on the 20th, placing their eggs singly on the leaves and sheath of the grain. On the 26th, after depositing a few eggs in the intervening time, they made their escape. The eggs may be described as follows: Length, $\frac{1}{2}$ m. m.; diameter, $\frac{1}{8}$ m. m.; form elongate oval; and when first deposited the color is shining, very light orange, which gradually deepens until just previous to hatching, when it is a livid red. One of these eggs deposited on May 21, hatched June 6, the larva being $\frac{3}{8}$ m. m. in length, brown anteriorly and red barred with brown posteriorly, legs yellow."

Careful search was made for the nymphs through the celery, and only a short distance on one row next to a ditch, were there any found, and then only an occasional one. They were like the mature form except the abdomen was blood red, soft and segmented. These fed in the group along with the adults. After reaching the mature stage they lose their appetite in about three weeks, so that after the 10th of August this year they did the celery no harm and gradually disappeared. Those kept in the breeding jar have not cared to feed, but have have collected in crevices in a semi-torpid state awaiting the coming of winter. They hibernate under boards and rubbish as does the tarnished plant bug.

PREVIOUS APPEARANCE ON CELERY.

With only one exception, no one, when asked regarding the bug, had ever seen it at work on celery before. This one was Mr. Frenthway of Kalamazoo who says he has seen it on his celery for the past seven years; only a few each year, not enough to do any harm. It certainly never has been numerous or others would have noticed its work.

DOES IT BREED ON CELERY?

This is a question which was studied very carefully while in the fields, and while it cannot be said positively that they do not breed on the plant at all, yet it seems very certain that such is the case. In every instance where the bugs were the worst, a rank growth of weeds was found near by. In most instances the weeds had been cut only a few days before the bugs appeared on the celery; but in some cases the weeds, while still standing, were nearly deserted and the celery attacked. The border of the celery field nearest the weeds always showed the first signs of attack,

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and was injured the worst for the first few days, after which the bugs would scatter so that no difference could be noticed.

The bugs are not general weed feeders like the tarnished plant bug, but are partial to a select few. They were found feeding on five different species bordering the celery fields, viz: *beggar-ticks, stick-tight or fork weed (*Bidens frondosa*); tick-seed (*Coreopsis trichosperma*); red root (*Amarantus retroflexus*); ground nut (*Apios tuberosa*), and great lobelia (*Lobelia syphilitica*). In addition to these Dr. Riley reports them on rosin weed (*Silphium*) and speed well (*Veronica peregrina*); Webster, on evening primrose (*Œnothera*); Forbes, on plantain (*Plantago lanceolata*), and sometimes on rag weed (*Ambrosia*) and smart weed (*Polygonum persicaria*). When found on these weeds they are always more plentiful than on celery near by; but in some instances where found in large numbers on these weeds a few days previously, the weeds had been deserted and the celery attacked. All seems to point toward their breeding elsewhere than on the celery at present; but even if this is true, should they continue to make celery a food plant, they will undoubtedly make it a breeding plant as well.

INEFFECTUAL REMEDIES.

While celery growers should not be discouraged at the start, for it is probable the bug can be controlled, yet it is quite evident after experimenting with the remedies usually effectual on such insects, that nearly all the remedies belong to this first class—the ineffectual. Our most effectual remedy on the true bugs is kerosene emulsion and this was the first to be tested on these bugs, but they were too well armored for it to penetrate. They were even placed in the dilute emulsion and forced to swim for five or ten minutes, but they soon recovered when taken out and were as lively as before. The full strength emulsion that would kill the tarnished plant bug as soon as dropped into it, would not kill the little negro bug for several minutes. Similar in nature, but even less effectual was "Little's Chemical Fluid," a prepared sheep dip and insecticide.

THE MORE EFFECTUAL REMEDIES.

Finding our most effectual remedies that kill by contact were of no avail, we next turned our attention to repellants and here found a vulnerable point. They were driven and scattered by offensive odors. Crude carbolic acid mixed with water at the rate of a tablespoonful to two gallons and sprinkled over the plants or mixed with air slaked lime or land plaster at the rate of a teacupful to each bushel and dusted over the plants, seemed to serve as a repellant the best of anything tried. The odor from a field sprinkled with carbolic acid water could be detected quite a distance off for at least twenty-four hours after the application was made. The odor from carbolized lime is not nearly as strong but seems to be more permanent. Lime alone was of little effect. It was intended to procure some gas lime (a refuse product in the manufacture of gas), but none could be obtained, and ammonia water with a strong sulphur and coal tar odor was taken instead. For the plants it had to be reduced at least seven-eighths, but the bugs could swim in it full strength without appar-

*The plants were determined for me by our station botanist, Mr. C. F. Wheeler.

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ent injury. As a repellant it did some good, though not equal to carbolic acid. Other repellants, such as coal-tar water, salt, sulphur, etc., were tried but were of no evident effect.

The only remedy found which would *kill* the bugs was hot water. Celery will endure a stream of water heated to 175° Fahrenheit, and the bugs succumb at 155°.

MEANS OF CONTROL.

We now come to the most important part, viz.: how to protect from future attacks. With the present knowledge that we have, probably the best method will be a combination of the carbolic acid and hot water. It is probable that the bugs will appear about the same time again next season, and careful watch should be kept from the 10th of July on. When they appear it will be in large numbers in some spot along the margin, and this is the time to treat them before they spread over the field. Carbolic acid can then be used on the plants surrounding the bug-infested patch for some distance back, or to make it more certain, on the remainder of the field; then, while the bugs are held in this little patch, dose them with hot water. It should be between 155 and 175 degrees Fah. when it strikes the bugs. The use of hot water is impracticable in a large field, but if used only on a little patch, is not so difficult. It may be applied with a cup from a pail or with a spray pump without the spraying nozzle. The water must be thrown in a stream, as it will cool too rapidly when thrown in a spray. The application of hot water will necessitate the use of a thermometer that the temperature may be accurately known.

A good precaution against attack would be to keep all weeds in the vicinity of the celery fields and along ditches cut down close through June and July so as to prevent the bugs from breeding on them. Unlike the tarnished plant bug, the amount of rubbish under which the negro bug can hibernate does not seem to affect its numbers in the least.

THE 13-SPOTTED LADY BIRD BEETLE (*Hippodamia 13-punctata*, Linn.).

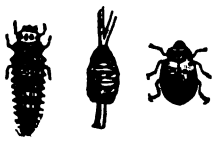

FIG. 9.—The three stages of the 13-spotted lady bird beetle, nat. size.

Many suspected this spotted beetle, which was so often present with the little negro bugs or found at the node after it was left by the bugs, of helping harm the celery; but the beetle was there only for the sap that issued from the wounds made by the bug. The beetle is one of our little friends as it feeds on plant lice and seldom, if at all, on the plants themselves.

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THE THREE-LINED THRIP (*Coleothrips trifasciata*, Fitch).

ORDER HEMIPTERA. FAMILY THRIPIDÆ.

FIG. 10.—The three-lined thrip; wings in natural position on one side and spread on the other. The line at the side shows the nat. size —(original).

In June and July these very minute sap sucking insects were common on the celery at the college. The species is our most common one in the heads of clover and is found on onions and various weeds. The individual specimens are only about one-eighth of an inch long, slender, and prettily marked with three white cross bands along the wings. They were found mostly on the tender central portion of the plants, often hid in considerable numbers between leaves, but as often scattered singly all over the plants. They no doubt assisted the leaf hoppers in making the celery look sickly, but they are so minute that they are not likely to do special harm unless very numerous. Should this occur, a spray of kerosene emulsion will diminish their numbers.

The method of preparing the kerosene emulsion may not be well known to all celery growers, and so it will be given: To two quarts of water add one quart of soft soap or one-fourth pound of hard soap, and heat the whole to boiling. When the soap is dissolved, take from the fire, add a pint of kerosene and agitate so thoroughly and rapidly with a force pump without the nozzle that the mixture will foam like milk when filling the dairyman's pail on a summer's evening. It should be churned in this way until the soap and oil become permanently mixed; that is, until the oil will not rise or appear on standing or when diluted. This will take at least three minutes rapid work. Stirring with a stick or spoon or slow pumping will not emulsify the soap and oil, though an egg beater may be used for a very small quantity. The emulsion as first made is too strong and will injure the plants unless diluted before applying. The soft soap emulsion should have as much water added as there is emulsion, and the hard soap emulsion, twice its bulk of water added and well stirred. They are now ready to be applied with a spray pump. The dilute emulsion should be stirred frequently in applying.

The above is the regular formula. The emulsion can be made in larger quantities in the same proportion, but if made in quantities larger than six or eight times the regular formula, it will be difficult to make a stable emulsion with a small hand force pump. This has been one of the discouraging features in the use of kerosene emulsion. It now seems evident that we can overcome that difficulty in a large measure. The method is to use the soft soap formula, as given above, without the water. The soft soap is heated until it becomes liquid and then, without water, add half as much oil as there has been soap used, emulsifying according to the directions given as above. The emulsion made in this way is as perfect as when used with water and it is so concentrated that it is one-third oil, or in other words, the same emulsion in this way occupies less than one-half the space that it would when made by the first formula given. An emulsion made in this way, without water, will need to be diluted with four times its own bulk of water before using.

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THE CELERY APHIS (*Rhopalosipum dianthi*, Schr).

ORDER HEMIPTERA. FAMILY APHIDÆ.

Nearly all plants are troubled with plant lice, or "green fly." On celery the above named species has been very common except from the latter part of July till the September rains came. Prof. T. A. Williams of the South Dakota station and Mr. F. A. Sirrene of the Iowa station pronounce it a very common species feeding on many plants. The dark, winged form has been the most conspicuous and so common at times that a dozen or more could be counted on single plants. The very young wingless ones were found early in the season and very late, but through the rest of the season neither young nor old were found. They probably breed on some other plant. Had they continued to breed in the field throughout the season as rapidly as they did in the breeding jar where confined, the plants would have suffered severely. As it is, they did little harm the present season. It would not be surprising if they should acquire a better liking for celery and in a few years should breed on it. As with the Thrip, kerosene emulsion becomes our "helper in the time of need."

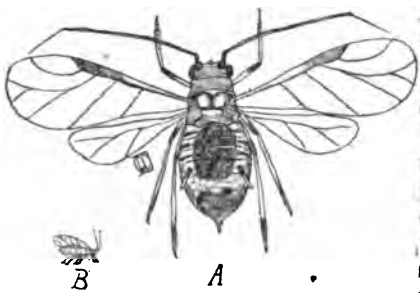

FIG. 11.—The celery aphis; enlarged and wings spread at A, side view and natural size at B —(original).

THE CELERY APHALARIA (*Aphalaria calthea*, Linn).

ORDER HEMIPTERA. FAMILY PSYLLIDÆ.

This is another insect very closely related to the celery Thrip and Aphis, that was on the plants in the spring along with these two species and about as common. Later in the season it was not found. It is about the size of the celery aphis and is of a yellowish brown color with a reddish tinge. The family to which it belongs is known as "jumping plant lice," because many of the species jump rather than fly. There are but few of the species known to be injurious, and it is not at all probable that this species will be a serious celery pest. If at any time it becomes so, the best remedy that can be suggested is the kerosene emulsion.

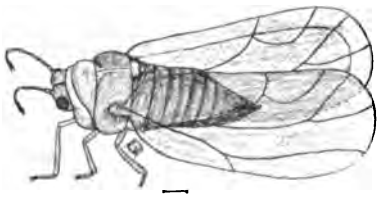

FIG. 12.—The Celery Aphalaria, enlarged as shown by the line beneath—(original).

OTHER LESS COMMON BUGS.

Besides the species of true bugs already considered, there were several others found less common on celery which were either seen sucking the sap or else known as plant feeders. The most conspicuous one of these is a common stink bug, *Euchistus tristigmus*. It is a broad flat bug that seems to prefer a mixed diet, as it was not only found with its beak thrust

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into the celery stalks but into some unfortunate larva that came in its way. The species is not common enough to do any great injury, but another darker and somewhat more slender species, closely related to the tarnished plant bug, may prove harmful. This species is known as the dusky plant bug, or *Deræocoris* (*Calocoris*) *rapidus* Say. It was only occasionally found on celery this season. Two other species, *Agalliastes associatus* Uhl. and *Poeciloscytus basalis* (?) Reut. were also occasionally found. Remedies suggested for the tarnished plant bug will apply also to these species.

CELERY BEETLES.

In this order of insects, the beetles, with their hard shelled wing covers, the injurious species are very few. What there are belong to one tribe —the flea beetles. They are given this name because when disturbed they will leap and jump like fleas, instead of flying. The largest of these little beetles is not over a twelfth of an inch long. In feeding they are not like the bugs just treated of, but have biting mouth parts with jaws that chew the leaves. The work of the flea beetles is easily recognized by the numerous little round holes that will be found eaten in the plant on which they feed. We always find them the worst in the early part of the season when the plants are young and tender. On the celery there were three species, *Longitarsus melanurus* (Fig. 13), *Crepidodera cucumeris*, and *Chætocnema parcipunctata* that were common in the order named. The second species named, along with the turnip flea beetle, *Phyllotreta vittata*, has often done much harm on our grounds to turnips, radishes, tomatoes and cabbages, and no doubt their work is familiar to all. They have often skeletonized the leaves so that little but veins would be left, or with the plants recently transplanted, have eaten them so that they have wilted and died. The work of the flea beetles on celery is the same as on other plants, and their work in spots last spring was considerable. If the beetles are at all numerous at transplanting or soon after, they will soon do the plants harm and the plants should be freed of them. To do this a very safe and sure means would be to use the hopperette spoken of under leaf hoppers on page 29. The beetles are very easily disturbed and leap so readily when it is warm that they are almost sure to be caught. Prof. Cook found a few years ago that a strong tobacco decoction worked admirably in keeping the little flea beetles off the plants. He used a double handful of tobacco dust to each gallon of boiling water.

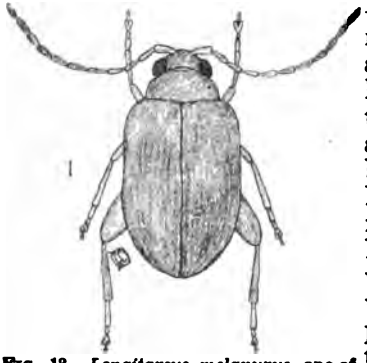

FIG. 13.—*Longitarsus melanurus*, one of the celery flea-beetles—(original).

THE CELERY CATERPILLAR (*Papilio asterias*, Fabr).

ORDER LEPIDOPTERA. FAMILY PAPILIONIDÆ.

We now come to the caterpillars that in the mature form become butterflies and moths. The first caterpillar of which we treat is one of the most conspicuous of all the celery insects. Its large size when nearly grown, and the striking color of yellow with black transverse bands, makes it on

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the dark green background of the celery leaf an object that is readily seen. It has been known as a celery caterpillar for some time. Every year we receive specimens of the caterpillar with a great many queries regarding it; not particularly because it is so plentiful, but because it so quickly catches the attention and arouses the curiosity. The Y-shaped yellow horns, that it throws out when annoyed, have no sting and are harmless. They are scent organs that emit a very disagreeable odor as a protection against its enemies.

FROM CATERPILLAR TO BUTTERFLY.

Of course, this caterpillar first hatched from an egg that was laid on the celery plant. At first the caterpillar is small, but in only a few weeks it has grown to its full size. Then it attaches itself to the stem and in a few hours time the caterpillar will have become a chrysalis as seen at *d*, Plate II. This is the resting period, as it has little power to move and eats nothing; but on some bright sunny morning a fresh, new, black and yellow butterfly comes from this pupa case and spreads her gauzy wings ready for flight. The butterfly feeds only on the sweets from flowers and does the celery no harm, except that, after a few days of her career, she haunts the celery field and deposits her eggs there for another brood. The caterpillars are the most common through September, but are occasionally seen in July and August. They live through the winter in the chrysalis stage.

OTHER FOOD PLANTS.

Parsnip, carrot and wild parsnip are fed upon by this caterpillar as readily as celery. Many other plants as caraway, parsley, sweet fennel, etc., belonging to the same family, also furnish it food.

NUMBERS REDUCED BY A PARASITE.

FIG. 14.—*Trogus exessorius* on the pupa case from which it has issued at the side. Twice natural size (orignal).

Whenever these caterpillars are present, wasp-like parasites with yellowish red bodies and black wings, may be seen darting through and around the plants in search of their host. The young of these parasites feed inside the caterpillars, and after the caterpillar has changed to a chrysalis, the parasite gnaws a hole in the case and comes forth instead of a butterfly. The parasite (*Trogus exessorius*) helps greatly to keep the number of caterpillars lessened.

REMEDIES.

As a usual thing the caterpillars will not be plentiful enough to need special attention. When so large and conspicuous, hand picking would be a ready remedy.

PARIS GREEN AS A REMEDY.

Our usual remedy for all caterpillars is Paris green or some of the arsenites, when they can be used without endangering the plant for food. Celery is a plant that will permit the poison to settle around the edible

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PLATE II.—Transformations of the celery caterpillar. *a*, egg; *b*. full grown caterpillar; *c*, front view of the head, showing the scent organs; *d*, chrysalis attached to a stem; *e*, butterfly at rest; *f*, butterfly with wings spread—(after Weed).

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portion at the base and caution has been used in recommending the arsenites. To test the possibility of poison being concealed between the stems, a row of plants was sprayed with Paris green at the rate of one pound to 175 gallons of water. Two weeks later a part of the same row was again sprayed with the same. The plants then stood another week when both lots were taken up, the roots, leaves and green stems taken off, and the remainder washed under the hydrant without separating the stalks. The bunches were in this way prepared as they are for market. They were then sent to our chemist for analysis.

His report is as follows:

Agricultural College, Mich., Oct. 12, 1893.

DEAR SIR—The specimens of celery sprayed with Paris green have been analyzed by Mr. Harrison, and the quantity of arsenic ($As_2 O_3$) determined in a pound of celery.

He finds the following quantities of arsenic in grains in one pound:

No. 1, sprayed once ..... .0244 grains
No. 2, sprayed twice ..... .0368 "

Yours truly,
R. C. KEDZIE.

This amount, Dr. Kedzie tells me personally, would not poison anyone at once but the effect would be evident with frequent use. The poison was freely applied, much more thoroughly than it generally would be, that our information might be certain whether or no it might be recommended. From the above analysis we can hardly recommend the use of any of the arsenites to protect celery against insects and must resort to anti-poisonous remedies.

THE ZEBRA CATERPILLAR (*Mamestra picta*, Harris).

ORDER LEPIDOPTERA. FAMILY NOCTUIDÆ.

A common zebra-like caterpillar that feeds on the leaves of celery. It is found occasionally early in the season but becomes more plentiful and often harmful later.

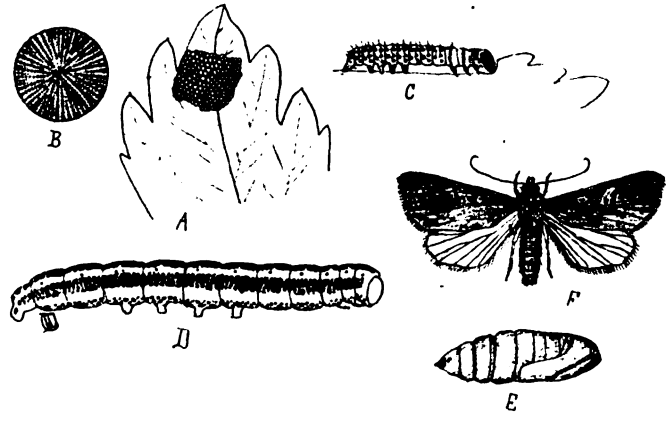

FIG. 15—*Mamestra picta* in its various stages. A, cluster of eggs as seen on a leaf; B, one of the eggs magnified. C, the young caterpillar; D, the mature caterpillar; E, the pupa; F, moth. All natural size except the single egg—(original).

Though not as large, this caterpillar is even prettier and more striking than the preceding species. For the seasons of 1891 and 1892, this was the most common celery pest reported to us. Last year it was very com-

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mon on our own celery, but it was the late brood, and although it nearly stripped the leaves in some places, the work came so late that the celery was nearly ready for market and had completed its growth. Parasites so thinned the numbers of the caterpiller last fall and early this summer that this season only a few appeared. The caterpillars feed only on the leaves, remaining in a group while young, but soon separate and feed by themselves.

LIFE HISTORY.

The eggs (see A, Fig. 15) are placed by the moth in a little group on the under side of the outer leaves, often near one edge. She is very prolific, laying in a compact bunch usually from 125 to 150 eggs, but in one instance this season a cluster of 452 eggs was counted. In from two to three weeks the eggs hatch into little hairy, speckled, white caterpillars with a black head and black crescent on the thorax. While in this condition they feed in a group and will suspend themselves by a web when disturbed. Their life in this attire lasts only two or three days when they don a bright new coat entirely different from the former one. The covering now is of much the same color that it is in the mature form. The head and legs are a reddish yellow and the rest of the body black except the two stripes, one bluish white and the other light yellow, connected by irregular cross lines. The caterpillars pass through several more moults as they grow. At maturity they measure nearly two inches in length. They then go into the ground where they pupate and after they remain in this resting stage for a short time, appear as a moth.

There are two broods each year, the first one coming in June and July and the second appearing in September. This last brood is hardly half grown when it leaves the celery for winter quarters in some protected place and comes forth early in the spring to complete its growth.

PARASITES.

The second brood last fall were largely parasitized by a small four-winged fly (*Microplitis mamestræ* Weed), bred from the zebra caterpillar and described several years ago by Dr. Weed. We have no access to his papers on this parasite, but perhaps a few notes from what was observed by myself will show the method of its work to those not familiar with the ways of parasites. By the time the caterpillar is nearly half grown the parasite inside the caterpillar is full grown. It then issues from the side of the caterpillar only a short distance in front of the last pair of legs. When only part way out it begins spinning its silky threads and attaching them firmly to the caterpillar around it. From this foundation it weaves out by looping the web outward nearly an eighth of an inch and fastening each time as it is brought back. After a little basket is formed in this way on one side, the parasite issues entirely and enters the web sack it has made. The next thing is to stretch and shape the sack, strengthening it all the while in the weak places. Then begins the gradual closing of the embryo cocoon around the parasite, finishing last on one side next the caterpillar, but before entirely enclosed it fastens webs that draw it tight to the side or else under the caterpillar. The work so far has taken the caterpillar about three quarters of an hour. The rest of the work is a series of weaving, turning, pushing and shaping till it has made the web so thick in two or three hours that it can no longer be seen. The cocoon is about one-

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fourth of an inch long. The caterpillar remains inactive after the parasite escapes and in a few days dies because of the internal injury done by the parasite. Safe in its tightly woven cocoon the parasite remains till the following spring when it comes forth as a winged fly to attack other caterpillars.

This season none of the Microplitis have been seen, but another parasite has been even more destructive to the Mamestra. These parasites are so minute they can hardly be seen with the naked eye, being three-fourths of a millimeter, or one thirty-fifth of an inch long. They do not attack the caterpillar but mature inside the eggs of the Mamestra and destroy them before they hatch. From two-thirds to three-fourths of most of the bunches were destroyed in this way. The parasitized eggs change to a dull lead color in a few days. Mr. Ashmead writes me that he has bred the same species from the cotton boll worm (*Heliothus armigera*) of the south and has given them the name *Telenomus heliothidis*.

In addition to these two parasites on *Mamestra picta*, two predaceous species were seen doing their share in destroying the eggs. One of these is a lady bird beetle (*Megilla maculata*), and the other is the tarnished plant bug (*Lygus tercicus*) previously treated of as a celery pest. Our celery pest in this case becomes a destroyer of another pest by inserting the lance of its beak into the eggs and sucking the contents. The lady bird beetle eats shell and all, but the bug leaves the shell entire though usually it is split where the lance enters. Seeing every once in a while quite a number of the egg cases empty and split open in this peculiar manner, I was led to watch for the cause of it. I soon found a tarnished plant bug at work on a cluster of eggs and watched it for some time. The eggs seemed to be greatly relished by the bug as it would repeatedly return when driven away and begin feeding at once. With so many vigilant foes to overcome, the zebra caterpillar will have difficulty in reaching maturity.

FOOD PLANTS.

The caterpillars of this species are very general feeders and are especially fond of most garden crops. They sometimes become plentiful enough to be injurious. Dr. Harris, in his "Insects Injurious to Vegetation," p. 451–2, gives us one of the earliest accounts of its destructive work. He mentions it as injurious to cabbages, cauliflowers, spinach and beets.

Dr. Riley in his 2d Mo. Report, p. 112 (Ill.), after giving habits and history, mentions, besides many weeds and flowers, asparagus in addition to those given by Harris.

In the 6th Ill. Report, p. 60, Thomas reports it being very partial to the leaves of the pea.

In the 5th Ent. Report of N. Y., p. 206–10 (Ill.), Dr. Lintner gives a very complete article on the species and adds currants and buckwheat to the list of food plants.

Here at our college we found them common on two species of clover, alsike and alfalfa.

REMEDIES.

When a cluster of eggs is found on a celery leaf or the very young larvæ are seen, they can be very easily crushed. With the older ones Dr. Lintner has found that pyrethrum powder mixed with five parts of flour and dusted

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over the caterpillars was a very satisfactory and speedy remedy. The powder can be bought already prepared at the stores. Care should be used, though, to see that the dealer obtains it fresh from the factory, as the powder loses its strength upon standing any great length of time. The powder is made from the blossoms of a plant similar to the chrysanthemum and is perfectly harmless to man and all animals breathing with lungs.

THE SPOTTED CUT-WORM (*Agrotis C-nigrum*, Linn.).

ORDER LEPIDOPTERA. FAMILY NOCTUIDÆ.

A fat, light colored caterpillar with dusky spots taken on the stalks of blanching celery. It is usually known as the corn cut-worm, because so often found injuring corn in hills.

A single specimen of this cut-worm was taken July 28, feeding on the stalks of a celery plant after it was boarded for blanching. The cut-worm pupated August 9, about half an inch below the surface of the ground and appeared as a moth September 5. This was the only cut-worm found, although quite a number of the moths were seen early in September, and also moths of *Hadena sputatrix* were quite plentiful in the various fields and probably this species feeds on celery also.

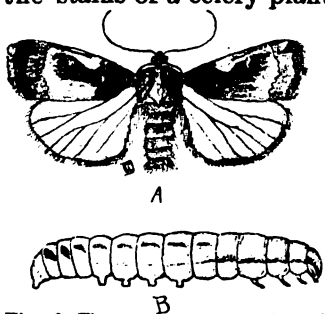

Fig. 16—The spotted cut-worm B, and moth A; both natural size—(original).

The c-nigrum is usually known best as a corn cut-worm. It is also known to destroy cabbages and other garden plants. In 1890 it was reared here on the currant by Prof. Cook from eggs found June 26. There are two broods each year, the last one remaining over winter in the grub state. There need be little fear of either of these cut worms becoming plentiful enough to injure the crop seriously as long as the soil is kept constantly stirred, as it is, from early spring to late fall. Should they become numerous, their work on the stalks may prove quite serious and in such a case bait traps of little bundles of clover poisoned with Paris green and distributed through the field, will be found helpful.

THE CELERY PLUSIA (*Plusia simplex*, Guen.).

ORDER LEPIDOPTERA. FAMILY NOCTUIDÆ.

Feeding on celery, lettuce and a few other plants; a naked, green, span worm, whose body is marked with eight white lines, and is provided with only twelve legs.—*Coquillett.*

A single specimen was taken in the pupa stage, wrapped in a white silken cocoon, and this rolled up in what was left of a leaf it had nearly eaten. The moth appeared on the 14th of July.

In the 11th Ill. Ent. Report (1882) p. 38, Mr. Coquillett reports this Plusia as destructive to celery in many gardens in the locality of Germantown, Ill. It is very closely related to the cabbage Plusia that becomes destructive at times and then apparently disappears for years before again attacking the cabbages in numbers. The habits of the celery Plusia are probably much the same. In the absence of a drawing, a few words from Mr. Coquillett's description may enable growers to identify the caterpillar. The body is very robust posteriorly, from whence it tapers to the head. It is a pale green, with a dark line on the back, and on each side three white lines, the middle one longest. Below and above the white stigmal line the body is dark green. The white spiracles are ringed with

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black. The head is green with black eyelets. Length one and one-fourth inches when full grown. The moth is slightly smaller than that of the spotted cut worm (Fig. 16) and is marked with light gray and dark brown with a silvered hook extending into the center of the front wings. Three broods each season are reported in Illinois by Mr. Coquillett.

REMEDIES.

The only remedy suggested is cold water. In his rearing experiments with the larvæ, Mr. Coquillet found the leaves when wet produced a disease of violent scouring that soon killed the caterpillars. The specimen reared by myself seems to be an exception to the rule as the weather was exceptionally wet up to nearly the time of the appearance of the moth. Perhaps it was owing to confinement that the water produced such an effect. Should this not prove sufficient, the pyrethrum powder spoken of under the zebra caterpillar no doubt will be effectual.

THE CELERY BORER (*Phlyctænia ferrugalis*, Hbn.).

ORDER LEPIDOPTERA. FAMILY PYRAUSTIDÆ.

Greenish translucent caterpillars, about one inch long, that were taken both boring in the stems and feeding on the leaves.

The habits of this species seem quite variable. It both bores in the stems and feeds on the leaves. While at Kalamazoo the 26th of August one of these caterpillars was found burrowing on the inside of the celery stalks close to the base. The crown had been eaten out and the plant nearly eaten up. The outer leaf stalks were channeled at the base and nothing left except the shell on the outer side. An immense amount of frass was left for so small a feeder. No other plants near this one seemed to have been molested. On the same day in other fields larvæ that appeared to be the same were taken quite plentifully either rolled up or sewed in between celery leaves. These caterpillars fed on the leaves around them and did not molest the stems. Both lots were placed in separate breeding jars, but from this on, all acted and fed alike. On the 28th the most of them webbed up between the leaves, or cut chunks of leaves out and pasted them to the jars. Others webbed up a day or two later. The first moths appeared the 14th of September. The borer appeared the next day and proved to be the same species as the others.

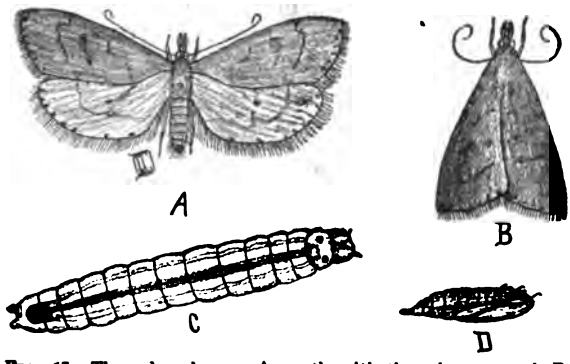

FIG. 17.—The celery borer. A, moth with the wings spread; B, same with the wings folded and at rest; C, top view of the full grown caterpillar; D, the pupa. Twice natural size—(original).

REFERENCES.

For the identification of this and the following species of small moths and references to them, I am indebted to Prof. C. H. Fernald, our well known authority on the Micro-lepidoptera. He writes me that to his knowledge the species has never been bred in this country before. In an

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English periodical (Entomologist's Monthly Magazine, Vol. XIV, pp. 200–204) we find all the early stages fully described. This species was bred on the leaves of boneset (*Eupatorium*), and was also taken on hedge nettle (*Stachys*) and strawberry leaves. It is thought to be two or more brooded.

DESCRIPTION.

The full grown larva is nearly an inch in length. Head and thoracic shield drab, with black markings as shown in the drawing. Along the body is a dark green dorsal line on each side of which is a very faint almost obscure opaque white line merging off to a translucent greenish and bordered by another opaque white line. On the sides is a very obscure yellowish green line. There is a distinct caudal shield of white and dark green. The caterpillar is sparsely covered with hairs.

The moth is reddish brown on the front wings and a grayish brown on the hind wings. Both have the faint black markings shown in the drawing.

REMEDY.

It is probable that the usual habit of this caterpillar is to draw the leaves together and feed on the leaves rather than bore in the stem. When feeding on the leaves alone it does much less harm. At present the species is not plentiful enough to cause any immediate alarm. Were the life history of the species better known, it is probable that some good means of control could be found.

THE SULPHUR COLORED TORTRIX (*Dichelia sulfureana*, Clem).

ORDER, LEPIDOPTERA. FAMILY, TORTRICIDÆ.

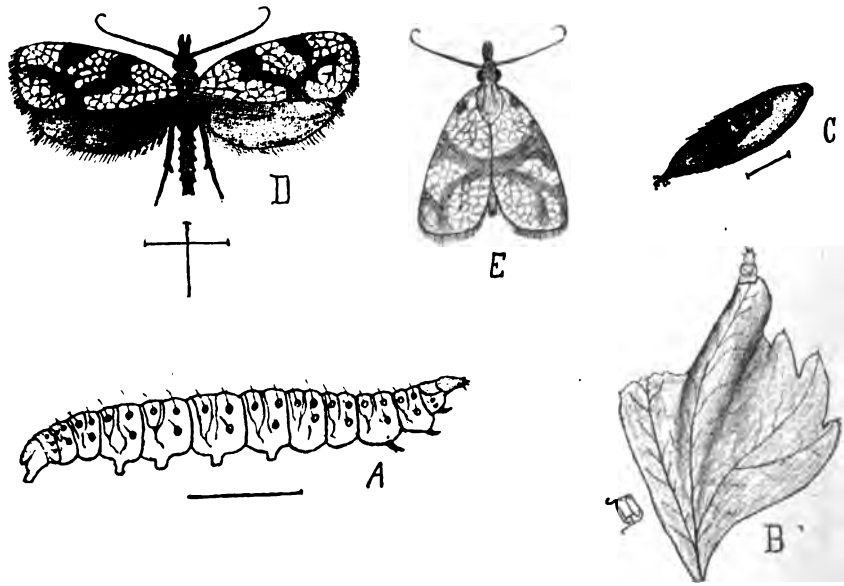

FIG. 18.—The sulphur colored tortrix. A, full grown caterpillar; B, the same as seen rolled in a leaf; C, the pupa; D, the moth with wings spread; E, same with wings closed and showing variation in color markings. The hair lines show natural size—(original).

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This was the most common celery leaf roller found this season. It was found more or less common in every locality visited. There are at least two broods and probably three. Of the first brood noticed the larvæ became full grown about the first of August and pupated early in the month, remaining from five to nine days in this state before issuing as moths. The next brood reached maturity the latter part of September and probably remain over winter as pupæ. Previous to this the species has been bred on clover and common buttercup (*Ranunculus acris*).

The larvæ are light green all except the tips of the mandibles (jaws), labrum (upper lip), and front feet which are black, and the head and thorax which are lighter—almost a flesh color. They live in leaves drawn together around them by a web which they spin, and feed on the adjoining leaves. They pupate in the same leaves in which they live. The little moths are a bright sulphur yellow with a network of small red lines and larger reddish brown bands on the primary wings. The hind wings are dusky. The band on the front wings varies considerably, the two extremes of the specimens reared being shown in the figure.

Should the species become still more common, and perceptibly reduce the foliage of the celery, it is probable that a great deal can be done to prevent the attack by cleaning up all leaves and refuse material left in the field in the fall and burning it. From our present knowledge, it would seem that this would destroy many winter pupæ.

THE CELERY TORTRIX (*Sericoris bipartitana*, Clem).

Only occasional specimens of this species were found. The larvæ feed on the leaves and live in a gallery made by drawing several leaves together.

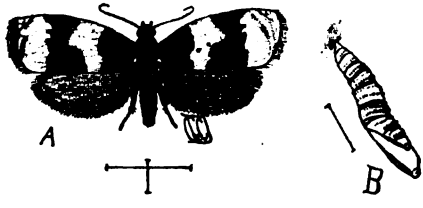

Fig. 19—The celery tortrix three times the natural size. A, moth; B, pupa—(original).

They are half a inch long, or a little more, quite slender and very active, throwing themselves with great violence when taken from the case. They are a dark greasy brown (almost black) with black shield on thorax, legs and plate on terminal segment black, prolegs and under side lighter. There are four shining dots above on each segment forming a square. On the sides are pits, one to each segment, and a dot above and below. The body is sparsely covered with hairs. They pupated early in August and appeared as a moth two weeks later. The moth is black and white with dark posterior wings and light abdomen. Prof. Fernald says the species has never been bred before to his knowledge.

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OTHER CATERPILLARS ON CELERY.

One of our common leaf rollers and one that we might expect to find on celery, as it is such a general feeder, is the oblique banded leaf roller (*Cacœcia rosaceana* Harr.). The pale green caterpillar is one of our largest, plumpest leaf rollers.

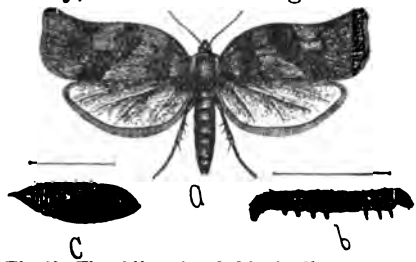

Fig. 20—The oblique banded leaf roller, *Cacœcia rosaceana*, *a*, moth; *b*, caterpillar; *c*, pupa —(after C. F. Baker).

Very similar in shape but of a uniform buff color is another moth (*Tortrix pallorana* Rob.) that was bred on the leaves of celery, August 17. It is a leaf roller with habits similar to the others, and is also quite a general feeder. Only one specimen of each of the above species was reared. Another caterpillar that destroyed at least two rather small plants by eating stems and leaves was the large hairy red and black one (*Pyrrharctia isabella* S. & A.) that is so common everywhere in the autumn. It is probable that this one specimen was rather partial to celery as others of the same species were found around celery that did not seem to feed on it at all. In confinement they eat it readily.

There were several other caterpillars (at least four species) that were taken feeding on celery but they did not reach maturity. One of these was a dark, dingy specimen, about half an inch long, that bored in the hearts of very young plants. It possibly was a cut-worm but looked more like the larva of a butterfly. Only the one was found and by an accident it escaped from confinement before reaching maturity. Another partly grown specimen was determined at Washington, D. C., as probably *Leucarctia acrea*.

"RED SPIDER" (*Tetranychus telarius*, Linn).

ORDER ACARINA. FAMILY TROMBIDIDÆ.

Our common little greenhouse mite, commonly known as "red spider," has taken a liking to celery this season and enrolls itself along with the celery insects. The latter part of the season was extremely dry, and favorable for its increase and, before the drought was broken, little blotches made by the mite began to appear in places quite thickly over the under side of the leaves. By raising the leaf the yellowish mites about the size of a pin head, will be seen through a slight web in which they live. They thrive only in a dry, hot atmosphere, and plenty of water is equivalent to poison for them.

Quite a number of other insects of various orders were collected on celery and although suspicion brands many of them as celery insects, they are not mentioned, as they were seen neither feeding nor breeding on the plant. Being in the fields only at intervals has interfered somewhat with extended observations that are so essential to the best work. Enough has probably been given to show the number of insects the celery grower must compete with in raising his crop.

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CELERY LEAF BLIGHT.

As the leaf blight is dwarfing and injuring celery so much in many localities and spreading to others, it was thought best to investigate this disease and give it a portion of our consideration along with the celery insects. In many places over the state the leaf blight is not known. In fields where celery has been grown on the same ground for a series of years, the blight through the hottest part of the season is severe. It is very generally known among celery growers in these places as "sun blight" and is supposed to be produced by the hot sun. One season, several years ago, it took nearly the whole celery crop at Kalamazoo. The blight has troubled the fields in the northern peninsula for the past three years, as Mr. Wheeler, our station botanist, learns through correspondence. The same letter says, "White Plume' and 'Golden Self-Bleaching' suffered more than other varieties. "Henderson's New Rose" has been entirely free from blight."

The blight is caused by a fungous disease working inside the celery leaves. No experimental work has been done on it here. Dr. B. T. Galloway has experimented on the blight in eastern fields and he kindly sends his unpublished notes for our use. The following are his notes in full:

CELERY LEAF BLIGHT, AS AFFECTED BY WATER SUPPLY TO THE PLANT.

Celery leaf blight, caused by *Cercospora apii*, is an exceedingly destructive disease, especially in the eastern part of the United States. For several years we have been making experiments in the hope that some means of cheaply preventing the trouble might be discovered. In 1890, 1891 and 1892 a number of trials made were with various fungicides, including both liquids and powders, but none of these gave very satisfactory results. In every case where the celery was planted on upland soil it blighted badly, despite the fact that the leaves were kept nearly covered with such well-known fungicides as Bordeaux mixture, ammoniacal solution of copper carbonate, etc. Where these preparations were used, however, the celery was not so badly attacked by leaf blight as the plants receiving no treatment at all.

Noticing that celery on low, moist ground was seldom severely injured by blight, an experiment was made in 1892 on upland soil to test the effect on the disease of water applied to the roots. The plants selected for the experiment were fully exposed to the sun and were set in such a way that they could be flooded sufficiently often to keep the ground always soaked. Without any further treatment these plants made a vigorous growth and were almost wholly free from blight. The average height of the plants when bleached was thirty-two inches. Plants in the same bed which received only water falling naturally, as rain, blighted very badly, in consequence of which there was not enough leaves to bleach when the time came for this operation. In height these plants averaged a little over eight inches, or about one-fourth that of the watered celery. The experiment shows the importance of an abundant water supply for this crop and explains in a measure why in certain localities celery is seldom affected with the disease. Of course it may not be practicable for all upland celery growers to water as extensively as seems necessary to keep the crop growing and free from disease, still there are no doubt many places where irrigation could be practiced at comparatively little expense, making the crop, even in regions where the soil and climate is naturally unfavorable, a certain and profitable one.

G. C. DAVIS.

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PEACH AND PLUM CULTURE IN MICHIGAN.

BY L. R. TAFT.

Bulletin No. 103.—Horticultural Department.

INTRODUCTION.

The importance of peach and plum growing as productive industries is but slightly appreciated, except by those persons who have visited the large commercial orchards in the fruit-growing sections, during the shipping season. During the past two or three years the crops have been so remunerative that the acreage has largely increased, and many persons have engaged in growing these fruits who have had little or no experience. In order to handle their orchards successfully they have endeavored to inform themselves as to the best methods to pursue and, as one source of information, this station has received numerous letters asking about the best locations and exposures for peach growing, the methods and time for pruning, the best soil and fertilizers, the varieties to plant, and the methods of combatting the various insects and diseases.

Appreciating the importance of these crops, and the necessity for accurate information as to the proper way to handle them, the following bulletin has been prepared. In the few pages that we shall devote to the subject, it is our aim to take up such topics relating to the cultivation of these fruits as seem of most importance, and regarding which the most inquiries have been received.

As is well known, it will be difficult to find two fruit growers who can agree upon all matters of planting, pruning, cultivation, etc., and it cannot be expected that every one will coincide with the methods of procedure here recommended. It must be understood that the character of the soil, of the season, the variety, or the surroundings, will exert such an influence that what may be a proper method of handling an orchard at one time or place, may be unwise at another. On the other hand, while, under average favorable conditions, some particular distance of planting, height of head and method and time of pruning will give best results, a slight deviation one way or the other will make but little difference, and the conditions may make it a rational one.

The methods here recommended have been found valuable in our own

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orchards and are used by the most successful fruit-growers of the state. Believing that no iron-clad rule will answer for all cases we have frequently outlined two or more methods of procedure and, as we have stated the conditions that would influence our selection, trust that the grower will have no difficulty in making a rational choice.

THE PEACH AND ITS CULTIVATION.

While it is probable that the peach was grown in Michigan at a much earlier date by the Indians and the early French settlers, the first well-authenticated planting of peach trees in the State was by a Mr. Burnett in Berrien county about 1809, some of which were alive in 1830.* As early as 1835 the peach crop of Berrien county began to be of commercial importance locally, and in 1839 the first peaches were sent to Chicago market from St. Joseph. From that time the planting gradually increased, not only in Berrien county, but it extended northward along the shore of Lake Michigan and in favorable locations in the interior counties. In 1874 there were more than 650,000 peach trees in Berrien county, but the scourge of the "yellows" destroyed most of the orchards and spread into the adjoining counties. As a method of holding the disease in check has been found, confidence in the crop as a commercial venture has returned, and in the county of Berrien alone it is estimated that 200,000 peach trees will be planted in the spring of 1894, while large areas will be set in other sections.

In favorable locations the peach has shown itself a profitable crop, and in the words of C. D. Lawton of Lawton, "It is an undoubted fact that the production of peaches in Western Michigan, when circumstances are favorable and the cultivator skilled in his work, is one of the most profitable branches of agricultural industry pursued in the United States," while another well known Michigan horticulturist has said in speaking of this fruit: "The peach is the most delicious, the most beautiful, and the most profitable of all our fruits, and nowhere on this continent is it grown to greater perfection than here in Michigan."

By the "Michigan peach belt" a tract from five to ten miles in width, extending from St. Joseph to Grand Haven, was originally meant, but the "belt" has in recent years both lengthened and broadened, as some of the orchards that have been most profitable are located in Oceana, Mason and Grand Traverse counties, and even as far north as Charlevoix (Lat. 45° 30′) they are grown with considerable certainty. Not only are there orchards which have produced profitable crops in favorable locations scattered all over the lake shore counties, but they can be found in nearly every county south of Montcalm (Lat. 43°), and during the past few years the climatic conditions have been such that, in many sections in the interior of the State, the crop has been nearly as sure as in the famed "peach belt" itself. It must be understood, however, that these orchards are in exceptionally favorable localities and that while they may succeed upon one acre, there will be a thousand where not only the crop, but the trees themselves will be destroyed in any except the more favorable seasons. With a proper selection of a location, especially if the ameliorating influence of Lake Michigan can be secured, with a suitable elevation, a

* Winslow's History of St. Joseph.

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well drained and properly fertilized soil, and intelligent treatment of the orchards, a crop can on an average be expected in two out of three if not three out of four years. The crop is, therefore, not absolutely a certain one, and judging from the past we may occasionally expect a winter in which, even in the peach growing sections, the peach trees except in unusually favorable locations will be badly injured, if not killed outright.

HARDINESS OF THE PEACH.

While the peach is classed among the tender fruits, it is only relatively so, as, if in good condition, the fruit buds of our best commercial varieties can withstand for a considerable length of time a temperature of twelve or fifteen degrees below zero, and instances have been known where peach trees have been subjected to eighteen or twenty degrees for a short time, and a fair crop secured the following summer.

In a location adapted to peach culture and with hardy varieties, it is not the extremely low temperatures that are to be feared, so much as the entering on the winter with trees in an unripened condition, or the injury likely to follow the swelling of the buds, during a warm spell in winter, while in some localities the danger from late spring frosts is even more to be dreaded. Among the other conditions that will greatly affect the amount of injury done by cold, are the circumstances under which the trees are thawed out. If after a very cold snap, when the thermometer has gone as low as minus eighteen or twenty degrees, the sun comes out bright and an immediate and rapid rise in temperature ensues, the fruit buds will almost invariably be destroyed, and the trees themselves may be seriously injured; on the other hand, if the sun remains clouded and the trees are slowly thawed out, many of the buds may, if they were in perfect condition, escape. Little, if anything, can be done to secure a gradual thawing out of the trees, but an earnest effort should be made to so handle the orchard that the trees will enter upon the winter in as perfect condition as possible. So much depends upon the effect of elevation and exposure, that the intelligent fruit grower will make a thorough investigation into the climatic condition possessed by a certain locality before selecting it as a site for a peach orchard.

A section of a bud that is in a perfect condition compared under a microscope with one from a bud in which development has commenced, will show how it is that one may escape while the other is injured. The dormant bud has its scales folded closely together but, in the one that has started, they have a loose open appearance that causes them to feel the effect of the slightest change in temperature; on the one hand they are easily chilled and, on the other, the thawing out will be so rapid that injury will almost certainly ensue. While the structural condition of the bud itself has much to do with its ability to withstand cold, it is probable that the main reason why the dormant bud is less susceptible to cold is that the vital functions of the tree are at rest while, after the buds have commenced to swell, the cell contents are in an active condition and the amount of water they contain is much increased.

INFLUENCE OF LAKE MICHIGAN.

The fruit growers in the western part of the State, with orchards within one to ten miles of Lake Michigan, have a location that is particularly

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favorable. During the month of February, when as a rule the temperature is lowest, and there is the most danger from severe cold, the record for twenty years shows that the average temperature at Ludington is about the same as in Branch and Hillsdale counties, and "careful records kept for several years at Traverse City and Northport show that the mean temperature during the winter months is several degrees higher there than at Ann Arbor" (Sanford Howard, Report State Board of Agriculture for 1867).

The *lowest* temperature to which the thermometer falls is, however, of more importance than is the *average* temperature and, in that respect, the lake, so long as the breezes are from the west, has a marked effect in keeping the temperature above zero. Again, in April it is desirable to have the growth held back as long as possible in order that the buds and blossoms may not be injured by late spring frosts. The observations of the Weather Service show that for the month of April, the average temperature at Grand Haven is about the same as in Roscommon county, nearly one hundred and fifty miles further north, while in May the isotherm of Grand Haven crosses the center of the State at Otsego county, or two hundred miles north of its initial point in the State. The lowest limit at Traverse City is about eight degrees F. higher than at St. Louis, Mo., which we think of as well to the south. The prevailing cold winds in winter are from the west and, before reaching the "peach belt," must pass over Lake Michigan, which is unfrozen in the coldest weather. It can be readily seen that the cold winds coming across the plains to the westward at a temperature of from 30 to 40 degrees, when they reach the lake with a temperature from 60 to 70 degrees warmer, will be considerably ameliorated in passing over the eighty or ninety miles of open water between the shores. In fact, the effect produced in extremely cold weather is often as much as twenty-five degrees, so that when it is twenty-five degrees below in Wisconsin, it is not likely to be zero at the same latitude in Michigan. A glance at the map will show that to escape its influence, a wind must come from some point to the east of north, from which direction extremely cold winds are almost unknown. The waters of Lake Huron and Lake Erie have a slight influence upon the temperature, as is shown by the isothermal charts.

A third effect of the lake is to delay the occurrence of the frosts in the autumn, thus giving grapes, peaches and other crops an opportunity to ripen. Although the average temperature of the spring and early summer is somewhat lowered by the influence of the cold water of the lake, it has the reverse effect during August, September and October, so that the average temperature of those months is about the same at Traverse City as in Eaton and Clinton counties.

ELEVATION AND EXPOSURE.

Except in the southern part of the Lake Shore "peach belt" (and even there it should not be entirely overlooked), it is of the utmost importance that proper regard should be paid to the selection of a site for a peach orchard. While we generally speak of elevation as being desirable, it is in a relative sense, principally, that it is of value, as a location upon a hillside where the land slopes off gradually to a valley one hundred feet below is far preferable to one on a level plateau, even though it be two or three hundred feet higher. Cold air is heavier than warm and, if the conditions

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are favorable, it will sink to the lowest possible level. A slope of a few feet, down to a little pocket-like depression, will be of but little value as this will soon fill with cold air; what is needed is a depression of considerable breadth or depth, or, if it is only a narrow valley, it should lead into another one into which the cold air can have uninterrupted flow. For this reason it is always desirable to have a stream, even though it be but a small one, flowing through the lower ground. Judge Ramsdell, of Traverse City, in "Michigan and its Resources," mentions a well authenticated case where a difference in temperature of eleven degrees was noticed in fourteen feet elevation, where the lower level was in the form of a pocket, but on his own farm he notes one instance of a difference of ten degrees in one hundred feet elevation, where there was a gradual slope towards Traverse Bay. As he well says, "A hundred feet elevation, with open air drainage to lower levels may determine the difference between a crop of fruit and a ruined orchard; and in enclosed valleys, or basins, twenty feet may do the same." The truth of this can be seen when it is understood that peach buds will withstand a temperature twelve or fifteen degrees below zero, while the trees are often killed at twenty-five degrees below. As a rule a hillside is preferable to a hilltop, as a location for a peach orchard, especially if the latter is of considerable extent, and level, both on account of the better air drainage, and because the trees will be less exposed in severe wind storms.

Regarding the best exposure for a peach orchard, it is not possible to offer any set rule, as the seasons and the locations vary to such an extent that it would not apply in all cases, and in all seasons. In one year a north slope will give better results than one with a westerly exposure, while the next year it may be reversed. The following general statement may, however, aid the prospective planter of a peach orchard. While a westerly slope has its advantages, near Lake Michigan, as the influence of the water is more marked on that side than on the other, it has the disadvantage of exposing the trees to the full force of the wind and sleet storms from that direction, which often cause great loss both of trees and fruit. The south slope is seldom advisable, as there the temperature often rises so high in bright days in winter, as to swell the buds, which are then likely to be injured by the first low temperature; moreover, and this is perhaps the more common cause of injury, the buds start earlier in the spring, than on the north slope, and are more likely to be destroyed by spring frosts. Another objection to the southern exposure, and one which also applies to an eastern slope, is that the early morning sun will more quickly thaw out the frozen buds, than it will when the trees are planted on the north or west side of the hill. We can only take the average of the seasons and say that in sections, within ten miles of the lake shore, where there is no intervening elevated land, the first choice seems to be the westerly and the second the northerly exposure, followed in order by the slopes to the east and south. In the southern portion of the state, away from the immediate influence of Lake Michigan, there seems to be but little choice between the east and west slopes, but the concensus of opinion among fruit growers seems to place them in the above order, except that, for some of the late sorts that barely ripen, the westerly slope is generally chosen. As stated above, the climatic conditions of a certain season may make one of the exposures, for the reasons given, by far preferable to either of the others, while the following winter may be so different, that the slope which was least adapted to success the previous year will give best results, and the proper course to pursue

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then is to select the exposure which, everything else being equal, has given best results for a term of years.

THE SOIL AND ITS PREPARATION.

The location and exposure have so much to do with the success or failure of a peach orchard that they are considered here, before the matter of soil is taken up. This seems to be eminently proper, as, while a variety of soils will give good results, peaches cannot be grown with success unless they have a suitable location. It is often said that any good corn or potato soil will do for peaches, but while this may be true it is well to be more explicit. The ideal soil for peaches is a well drained, rich sandy loam. Not only is it as well or better adapted to the growth of the tree than any other, but they are more sure to bear, will ripen earlier, and the fruit is larger, of better quality and superior in flavor to those grown on a clay, or clay loam.

Peaches are very susceptible to the presence of water at their roots, and unless the land has thorough natural drainage, it should be freed of its surplus water by means of tile drains. The fact that heavy soils are likely to be somewhat wet, owing to their having an impervious hard-pan, is another reason in addition to those above given, why peaches are preferably grown on a light soil. If well drained and at a suitable elevation, good results can, however, be obtained on a clay soil.

While a location where the land is in sod can be selected and the trees set the same season, it is better to give at least one year to preparation, using the land for some hoed crop. If it can be secured, a clover sod turned under in the Fall is excellent for an orchard, or for any fruit crop. On light soils where the sod is thin, it can be brought into fair condition for the trees if plowed the Fall previous to planting. Before the trees are set it will be well to replow, although a thorough dragging will answer.

Except in very favorable locations, it is hardly safe to set peaches on new land where there is much vegetable matter in the soil, as it is likely to cause a rank and late growth, which is likely to be winter-killed. After one or two crops have been taken off from the land, the trees can be safely planted. Another reason for delay is that the soil is so light, owing to the presence of the partially decayed roots and leaves, that unless care is taken to obtain clear loam to pack around the roots, the trees are likely to dry out. The leaves and other litter, however, are excellent to place around the trees, upon the surface, as mulch.

METHODS AND DISTANCES FOR PLANTING.

When only a few trees are to be set, the holes can be dug with a spade, but for a large orchard, labor can be saved if two furrows are run so as to open up all of the rows in both directions. This will allow the trees to be set at the intersections of the rows, without the labor of digging the holes by hand. The trees may be planted at various distances and be arranged in several ways. When planted in squares, some growers place the trees as close as sixteen feet each way; very few plant at less than eighteen feet, however, and a majority are now setting their orchards with trees at least twenty feet apart, requiring about one hundred and nine trees per acre.

In some localities it is a common practice to plant in rectangles with the trees from twenty by eighteen and twenty by sixteen feet to twenty by fifteen, or as near as eighteen by twelve feet. At the last distance, the

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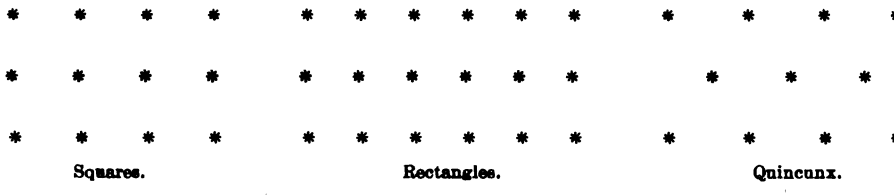
trees, while small, have plenty of room but, after a few years have passed, they begin to crowd. Such close planting is not advisable unless one has an abundance of trees, when it may be economy of space to plant as above, and, when the branches meet, take out every other one so that they will be eighteen by twenty-four feet. At this distance, almost exactly one hundred trees will go upon one acre. With the trees twenty by fifteen feet there will be the same chance to go between the rows one way as when they are twenty by twenty feet, and one hundred and forty-five trees can be set to the acre, or one-third more than when the square is used. After the trees are five or six years old, they will interlace and the crops will be but little larger than would be borne by the smaller number of trees. The same objection will hold against the trees planted twenty-two by sixteen feet, and at either distance it will be more difficult to cultivate than when they are in squares.

A third method of planting, known as the quincunx, or triangular arrangement, consists in arranging the trees in diagonal lines across the orchard, and thus making room for about one-eighth more trees than can be planted by the square method, with the trees the same distance apart.

METHODS OF ARRANGING TREES.



This is an increase worth considering, but the distance between the rows will be decreased in the same proportion, and this is a serious objection. It does not hold, however, when the trees are placed twenty feet apart in the rows and the rows are at the same distance. In this way the same number of trees can be set and there will be an increase of about one-eighth in the distance measured diagonally between the trees, which will then be about twenty-two and one-half feet apart. While this distance will be desirable on rich soil, if the orchard is to be on light sand or sandy loam, the other may answer.

In laying out the land, it is a good plan to first stake it off into squares not over four hundred feet on a side. If two opposite sides are marked with stakes, at intervals the same as the proposed distances between the trees, the location of the trees can be fixed by stretching a line or wire marked at the proposed distances, and setting stakes at those points. A No. 14 galvanized wire will be found best for the purpose, as it will not stretch, and the trees can be more accurately located. The points for the trees can be marked on the wire by twisting around it a short piece of small wire and fastening it in place by means of a drop of solder. If a garden line is used instead of a wire, one should be selected that will not stretch, and the distances can be marked by tying short pieces of twine about it. The holes for the trees should be about one foot deep and eighteen inches in diameter, varying with the size of the roots and the character of the soil. The trees should be set sufficiently deep that the

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old stock will be covered, and the holes should be deep and wide enough to take in the roots without cramping them. Upon soil with a stiff hardpan, it is well to dig the holes considerably wider than is needed by the roots, as it will give them a better opportunity to develop.

In setting the trees, the soil should be carefully worked in among the roots and firmly packed around them, taking pains by first filling the hole half full of soil, that they are not bruised. The fine surface soil should be used for the lower half of the hole, and then, after the roots have been well covered, if they are partly rotted the sods can be put in, filling up the hole with the subsoil.

The surface should be left level or slightly sloping toward the stems of the trees. The opposite plan of mounding the soil around the trees is not a good one except for fall-set trees, or in localities where mice are troublesome, when they may be banked up in the Fall and the soil leveled off in the Spring.

SELECTION OF TREES AND VARIETIES.

One of the pivotal steps in peach growing is the selection of the trees and the varieties, as, however well the location may be chosen, or with what care the orchard may have been handled, there will be no fruits to reward one's toil unless a judicious selection has been made.

If the grower has the necessary knowledge and can wait two years for his trees, it will be as well, perhaps, if many trees are wanted, for him to propagate them for himself, but the average person will do better to purchase his trees of a nurseryman, who knows how and has the time to grow and care for them in the best manner. Everything else being equal, it is better to obtain nursery stock of all kinds from a nurseryman in the same locality, or where the soil and climate will be similar to that of the orchard. If purchased near home it will enable one to select the trees in the nursery, and there will then be a better opportunity to get trees that are satisfactory. In case the local nurseries are not patronized, the next best thing is to write to some of the large nurseries of this or adjoining states, giving the number and age of the trees, the names of the varieties desired and any other facts, and ask for prices. Before giving a large order it will be well to have samples sent on for examination, and if everything is satisfactory the trees could then be ordered from the man who furnishes the lowest estimate, with a fair degree of safety. With all nurserymen, however, this will not be a safe thing to do, as a low price may mean inferior or worthless trees, and (although there should be a distinct understanding that there is to be no substitution) inferior varieties. If one is familiar with the standing of the different firms, and if the samples are satisfactory, it becomes a plain business transaction, and the trees ordered will be most likely true to name and up to the standard in size and general appearance.

Many person advocate the purchasing of trees from local tree agents who are known to be honest and reliable, but if a large number of trees are wanted you can obtain them from the nurseryman, at as low a price as can the agent who must charge for handling the trees, and besides, since they must pass through the hands of a third party, there is the increased risk that the varieties are incorrect, or that the trees will become dry, or injured in some way. The fruit grower has little use for the average traveling tree agent; although many of the so called tree pedlers are honest, understand

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their business and sell trees true to name and at fair prices, the proportion is very small. Too often they fill orders for new and high priced varieties, with seedlings, or with cull or surplus stock, made up of any and all varieties purchased from some grower. As a rule his prices for trees of standard varieties are from two to five times what they can be obtained for direct from the nurseryman, and the novelties, many of which are frauds on their very face, have not been sufficiently tested to determine their value, and are seldom worth the price charged for them. While the large grower cannot, as a rule, afford to get his trees from a tree agent, there may be instances, when only a few trees of common sorts are wanted that the order can be given with safety, if the agent is known to represent a reliable firm, and the trees can be obtained as cheaply as when obtained direct and the carriage paid. The general rule can be given, that it is unwise from a commercial standpoint, to order from an agent a novelty of which nothing is known, except what can be learned from the gorgeous plates he shows, and his lauding words.

It has been stated, that it is well to purchase trees grown in a similar climate and soil; this is not because other trees may not be as good of themselves, but because trees placed under conditions unlike those under which they have been grown, are obliged to accustom themselves to the changed conditions. This is especially true of trees grown in a warm climate, where the soil is rich and moist, and carried to a cooler climate with a short season and a dry sandy soil. The original growth will be soft and watery, and with the usual amount of roots found on nursery trees it will be found necessary to cut the top back severely, thus giving an added check to the trees. It is not uncommon, when the large, bare stem is exposed in this way, for the bark to be burned, and if the tree recovers at all, it will not be for several years. These conditions and results are more common with the cherry and pear than with the peach.

AGE AND SIZE OF TREES.

A tree one year from the bud is of the proper age for planting, and anything older should be rejected at any price. In digging a two-year old tree all of the branching roots are cut off, and when set out it does not recover itself until the second year, by which time a vigorous one-year tree will have caught up with it, and will soon outstrip it. A medium-sized tree is best to plant, a large tree with its soft, watery stem and branches being rejected for the reasons given above. Trees whose small size is owing to a poor soil, or unfavorable season, may, if placed in good soil, make a satisfactory growth, but it is often the case that the small size of cull trees is owing to some inherent weakness in the stock or cion, and although they may in time outgrow it, the slight saving in price is not enough to insure the risk.

Of fully as much and probably of more importance than the size and shape of the top is the condition of the roots. They should be well branched and the divisions should not be less than six inches in length. While this will not be the entire length of the roots in trees one year from bud, the tissues of the roots will be so soft that rootlets will readily be sent out.

CARE OF THE TREES BEFORE PLANTING.

If a grower raises his own trees they should be dug in the Fall and carefully heeled-in, in some well drained place, convenient to the orchard site.

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The trench should be dug one foot deep and two feet wide, in which the trees should be placed, slanting toward the south at an angle of 45°. If placed in single layers so that the soil can be thoroughly worked in between the roots, they will come out in the Spring in good condition.

Care should be taken to select a spot free from stubble or other litter, and no straw or hay should be used to cover the trees, as it would invite the field mice which might work havoc with them. If in a wind-swept spot it would be well to cover the trees with evergreen boughs, or to provide some similar windbreak, but it is hardly advisable to bury the trees in the soil. If the trees are purchased, it is best to obtain them in the Fall and heel them in, as above described. By thus doing, you are more likely to get the first pick of the trees, while if left until Spring the desirable varieties are likely to be sold out, and only culls left. Besides in the rush of the Spring packing there are more chances of errors occurring and the packing may be put off until the buds have started, and a delay in transit is more likely to cause the trees to dry out, or heat, than in the cool weather of late Fall.

Whether purchased, or grown, precautions should be taken not to expose the roots to the sun, or drying winds. Blankets, tarpaulins, or straw should be at hand to cover them, and if to be left any length of time when there is danger from either sun, wind, or frost they should be heeled-in. It frequently happens that trees become dry or shriveled in transit, so that if planted in that condition a large part of them will be lost. If not too far gone, the bark and buds can be induced to fill out so that the tree will be far more likely to grow, if it is buried tops and all for a week or ten days in moist soil.

When trees are shipped any distance, a considerable saving in the cost of boxing and freight would result if they are trimmed before they are packed. The nurseryman can do it as cheaply as the planter, and a saving of from two to five dollars can be made on each thousand trees, if they are pruned as described later on.

SELECTION OF THE VARIETIES.

In making out a list of varieties of peaches for planting, the first consideration should be the hardiness of the trees and of the buds. Many of the kinds that are spoken of as shy bearers are so only because the fruit buds are so tender that in an average year they are destroyed; of course such kinds are of little value and should not be considered in selecting varieties, especially for a commercial orchard. Many of the kinds that are valuable in the States to the south of us do not mature in Michigan and all such should be ruled out. Whether for home use or market a list should be chosen that will furnish fruit in succession throughout the season.

The varieties should be regular and abundant bearers, and the fruit produced of good size and showy in appearance. The flesh should be firm enough to ship well, yet fine, juicy and melting, and of a rich, luscious flavor. For most markets a free-stone peach is desired. While a variety with yellow skin and crimson cheek is very attractive those with white and red are perhaps equally valuable. A moderately thick skin is desirable in a peach for distant shipment, but its quality is to the same extent lessened, while a thick fuzzy covering is in no way of value and detracts much from the value as a dessert fruit and for market purposes. As is the case with most fruits, it is impossible to combine all of these qualities in a high

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degree in a single variety, as, if they are of high flavor, rich and melting, they are generally deficient in hardiness.

One of the difficulties in offering a list of fruits, is, that sorts which succeed well in one locality do not seem to thrive in another. If the most successful fruit growers in the State were asked to furnish a list of their most profitable varieties, the ten sorts having the most votes would be: Hale, Lewis, St. John, Richmond, Barnard (or Snow's Orange), Jacques, Gold Drop, Late Barnard, Hill Chili, and Smock.

Although the above varieties have been found to succeed quite generally, attention should be paid to the character of the soil, in making out a list for planting.

Hill Chili needs rich, well-drained soil, as, if planted upon light sand, the fruit will be undersized, and upon cold, wet land they are very fuzzy, and late in ripening.

The Barnard is another peach that needs a fairly rich soil, but it does better upon one that is of a sandy rather than of a clay nature.

Conkling and Wager seem to thrive upon a rather heavy soil, while Hale, Lewis, Jacques, Gold Drop, and Smock are generally fruitful upon either sand or clay.

As varieties for home use that are of rather better quality, but less hardy in fruit-bud, Honest John, Mountain Rose and Oldmixon may be used, and in favorable locations they will be found good market sorts.

Salway is an excellent late variety but should not be planted except in favorable localities, as it requires a long season. These kinds with, if desired, a few Alexander (or Waterloo) and Early Rivers for early sorts can be generally relied on in all parts of the State, where any of the varieties will grow. The following lists for orchards of one thousand trees have been submitted by the well-known, successful peach growers, whose names are prefixed:

J. N. Stearns, Kalamazoo: Hale Early 50, Lewis 50, Richmond 100, Barnard (or Snow's Orange) 100, Jacques Rareripe 100, Kalamazoo 300, Gold Drop 200, and Smock 100. J. F. Taylor, Douglas: Wilder 25, Rivers 25, Hale 25, St. John (Lewis or Mountain Rose) 100, Early Barnard 100, Jacques 100, Late Barnard 100, Hill Chili 100, Bronson 100, Engle Mammoth 100, Gold Drop 100, Smock 100, Allen 25. A. Hamilton, Ganges, recommends the following: Waterloo, Rivers, Hale, St. John, Barnard, Early Crawford, Engle Mammoth, Bronson, Hill Chili, and Smock. "I would omit Late Crawford, because it is a shy bearer, and let Engle Mammoth and Hill Chili take its place." It will be noticed that none of the large yellow peaches of the Crawford class, such as Early and Late Crawford, Foster, Red Cheek Melocoton and Susquehanna are included, and the fruit grower will say that they are such shy bearers that he can get five bushels of almost any of the kinds recommended to one from the Crawfords. While they are excellent in fruit, there are few if any sections of the State where they are sufficiently reliable to merit their being planted upon a large scale as market sorts.

There are a large number of new sorts that have been sufficiently tested for us to say that they are worthy of planting, but from our present knowledge they can hardly be placed in a short list. The most promising are: Kalamazoo, Elberta, Engle Mammoth, Beer Smock, and Crosby. Other varieties that have a local reputation are Brigdon, Corner and Gudgeon. While several of these are undoubtedly seedlings it is quite likely that others are old varieties whose names have been lost. Several growers

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who have watched them carefully are propagating and planting them exclusively. C. Engle, of Paw Paw, also has a large number of new sorts mostly seedlings of Hale, Crawford and Chili that in some respects are better than the parents, and are being watched with much interest. From its behavior with its originator (J. N. Stearns), the Kalamazoo promises to be one of the most profitable peaches, and is certainly worthy of a trial on a somewhat extensive scale.

WATERING THE TREES.

As generally applied, the water given to trees at the time of, or after transplanting, does more harm than good. If the roots of the trees are not exposed to drying winds and if the soil is not unusually dry from a prolonged drought, no water will be necessary. If, however, the soil is dry, it will be well to give a thorough watering at the time of transplanting. This can best be done by filling the hole half full of soil and working it around the roots as recommended above, except that less care is required than when no water is to be applied. Then fill up the hole with water and after it has soaked in, the planting can be completed. The water will not only moisten the soil, but will puddle it in around the roots much better than could be done in any other way. As a rule no other watering will be necessary, but if it becomes desirable it should be done in much the same way, the soil being drawn back from around the trees so as to form a basin for the water, and after it has soaked in the soil can be replaced.

The stirring of the soil of itself will be a benefit to the tree and if applied in this way it will soak down to the roots where it will be of use. As generally applied none of the water reaches the roots, and although it may benefit the tree for a few days by checking evaporation from the soil, it soon dries out and, a crust forming, the evaporation is increased and more harm than good is done to the tree. The one thing that is most necessary, to secure growth in a tree, is to so conserve the moisture in the soil that at all times it is present about the roots. As all the food taken from the soil by the root must be in a solution, the importance of this can be seen. If a crust can be prevented from forming, the evaporation will be decreased and any light, open material spread over the surface will add in the retention of the soil moisture. A mulch of almost any vegetable matter is excellent for the purpose, and waste hay, straw, or corn stalks are often used. They have one serious fault, as they induce the roots to grow in the moist, surface soil, and for this reason are not desirable with the peach and other trees that are liable to injury during the Winter.

The orchardist has, however, a mulch at his disposal that is easier to apply than those mentioned above and it in every way is preferable. It is secured by stirring the surface soil to the depth of perhaps two inches, once in a week or ten days during the dry weather. In the early Spring, when the ground is full of moisture it is well to aid in drying out the surface by working to the depth of three or four inches, but later on when the opposite condition is necessary the depth should not be over one and one-half to two inches. If some shallow-working tool is used during a dry Summer, it will be found that, although the surface soil which has been loosened has lost its moisture, the underlying soil in which the roots feed has been able to retain its moisture by the mulch-like action of the surface soil.

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If for any reason it is not possible to give the care outlined above, a mulch should be put on covering a space at least three feet more in diameter than the hole dug for the tree. This should be left on until the middle of August when it should be removed to allow the trees to ripen off for Winter. In localities where field mice are not troublesome the mulch may be replaced around the trees as soon as the ground freezes, but otherwise it is not safe. While some hoed crop can be grown in a young orchard for two or three years with little injury to the trees, it is not advisable to use those that will require much stirring of the soil to harvest them, during August or September. For this reason the potato is not a good crop, except in case of late varieties that are not harvested until after the middle of October. Corn, late cabbages, squashes, tomatoes, melons and similar crops that need cultivation up to the first of August, or that will allow the trees to be worked up to that time, should always be chosen, and in no case should anything be grown within three feet six inches of the trees and if given four or five feet it would be better for them. For the reason that the trees cannot be cultivated, a grain crop is not advisable. It is a mistaken idea that cultivation will cause a late growth and consequent winter-killing. Improper cultivation may do it, but, as recommended above, there need be no fear. If a strip four feet wide on each side of the rows is kept cultivated, the remaining ground may be seeded down, the first year or so. Fruit trees, like most other plants, make their growth during the early part of the season, the period during which the branches of any one kind of tree elongates, varying with the character of the season, as influencing the food supply. When very dry, during the month of July, the trees stop growing prematurely and at once begin to ripen their wood for the winter, storing up in the meantime materials for the next year's growth.

If, after this period of partial rest, the climatic and soil conditions are favorable to a renewal of growth, *i. e.*, warmth and moisture present—the buds that should remain dormant until the following Spring will expand and a second growth will ensue. In this way we can account for the blossoming of peach, plum, and other trees in September and October. The wood thus formed will not ripen properly and the buds will be so imperfectly developed that the growth the next Spring will be very weak. The regular and uninterrupted stirring of the soil during the months of May, June and July will conserve the moisture and tend to prevent a premature cessation of growth.

If not continued later than the tenth to the fifteenth of August, the wood will have an abundant time to ripen and there will be no danger either of unripened wood, or of a second growth. As oftener practiced, however, cultivation may do harm. The orchards are worked during May and June, but, as the other work is pressing, no cultivation is given during July and August, until, as the ground is getting weedy, it is dragged in September; a drouth in July will stop the growth before it is completed and the late cultivation joined with warm rains will almost surely promote a second growth to be injured by the Winter. In a general way, the cultivation should be about the same, during the next one or two years, as for the first year after planting, but after the fourth year, at latest, it is hardly advisable to crop the land unless the trees are at least twenty feet apart. In some localities, it is a favorite practice to sow rye broadcast, the last time the ground is worked in August and turn it under the following spring. It is claimed that the growth of the rye aids the trees in ripening off by

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taking from them some of their food supply and thus lessening the danger of a second growth. It also admits of later cultivation. The decomposing rye will add nothing to the supply of plant food, but it will place in the soil a considerable amount of humus in an available form for the use of the plant, and will be of value in lightening up a heavy soil. Especially in the dry seasons and for bearing trees of late varieties, it is well to keep up cultivation until the end of August as the moisture thus conserved will increase the size and hasten the ripening of the fruit. With kinds that tend to overbear, such as Hill Chili and Gold Drop, moderately late cultivation will enable them to carry a much larger crop and develop them to a good size, than if there is no cultivation after the first of August.

PRUNING AT TIME OF TRANSPLANTING.

As a rule if the trees have been properly dug, the roots of one-year old peach trees will need but little pruning. At best, the roots that have been bruised or broken, should be smoothly cut off, and it is generally well to smooth off the ends of all roots over one-fourth of an inch in diameter that have ragged ends. While by no means necessary, it will hasten the callousing and thus enable the trees to throw out roots earlier in the season. It will be best to have this done in the Fall as it will enable the trees to form the callous during the Winter. In fact, if trees are dug in the Fall any cutting of the roots in the Spring may do more harm than good. The pruning required for the top of the peach is unlike that required for any of the other fruit trees, except such as are also planted when one-year old, when it would be the same. Nearly all growers now cut back their peach trees to a single stem, removing all branches close to the stem and cutting this off about one foot above the point from which the lowest branches are to start. The strong axillary buds will then develop into vigorous shoots. A modified form of this pruning is to leave four or five of the branches arranged at intervals along and around the stem, cutting them off so that one strong bud will be left on each, while others go still further and cut the branches so as to leave five or six with a length of about six inches. Although good trees can be grown from either method of pruning, the first is preferable, as the growths made will be stronger than they would be by either of the other methods. For nearly every situation it will be best to start the trees so as to form a moderately low head, and if the first branches are two to two and one-half feet from the ground it will be in accordance with the methods of the best orchardists. If started with low heads, the trunks will not only be short but they will

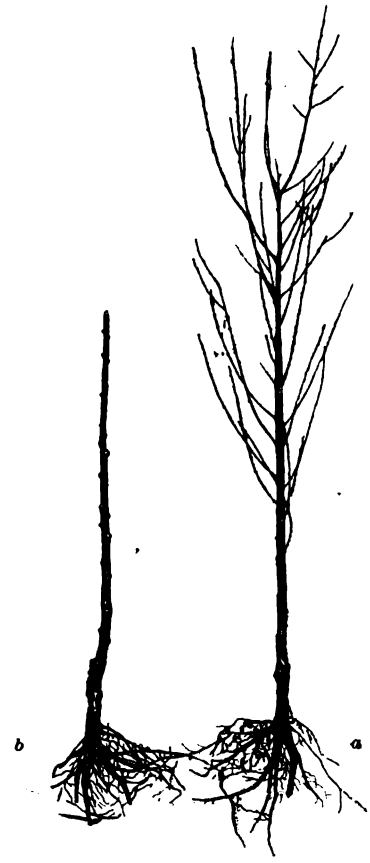

FIG. 1.—NURSERY TREES.
a unpruned. *b* pruned.

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be shaded from the hot sun and less likely to be injured by the freezing and thawing of Winter. Short trunks will bring the branches nearer the ground and will facilitate the pruning, thinning and gathering of the fruit. The low heads should not be carried to the extreme of starting at the ground, as this would hinder proper cultivation and favor the workings of the borer.

FORMING THE HEAD.

Some growers after heading the trees in, do not attempt to do anything towards forming the heads until the following spring, allowing them to grow as they please during the summer unless they become quite noticeably misshapen, while others go around occasionally and rub out the surplus shoots. In the spring the head is formed by selecting four or five strong branches so located as to be well distributed along the stem for a distance of one foot down from the top and pointing in different directions, thus forming a well balanced head. A strong branch with an upright tendency should be selected as a leading shoot. It will be found preferable to have the branches somewhat distributed, as they will be less likely to break down later on than if they were all crowded together at one point. The side shoots that are left should be cut back about one-half their length. The leader should be kept somewhat longer and trained so that other branches will be given off from it. If this is done it will be found much better than to have all the branches needed to form the head developed as side shoots from those left upon the tree when the head was first formed.

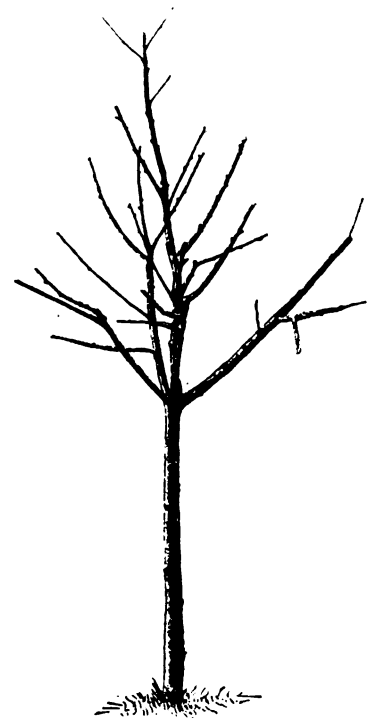

FIG. 2.—PRUNING AT END OF TWO YEARS.

PRUNING THE TREES.

After the first year, as a rule, only one annual pruning is given although if any shoots are noticed that are out of place, it is well to remove them at any time.

The spring is considered to be the best time for the pruning of the peach, and for that matter of all trees, the work being performed after the severe weather of winter is over. For the best results a peach tree can carry about so many branches and so much fruit and to secure this, one of the following two methods of pruning is commonly employed, the first being to head back, the other to thin out the small branches. By heading back the branches a low, rounded and symmetrical tree is secured, upon which the fruit can be readily thinned and picked; the buds remaining will develop a few strong shoots, well back towards the base of the branches, the tree will be less likely to break down and the stem and main shoots being sheltered from the sun, will be more vigorous and healthy,

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and consequently the trees will be long-lived. When pruned by the other method, the small branches along the shoots being removed, there is only a brush-like tuft of twigs at the ends of long slender branches. As a rule growth takes place from a number of weak buds near the end of the branches, and the shoots thus formed transmit their own weakness to those to which they give rise. The fruit being formed at the extremi-

FIG. 8.—PRUNING BY HEADING IN.

ties of the pole-like and comparatively weak branches, the weight, with the increased leverage, often breaks them down. The sap must pass the entire length of the branches before it reaches the fruit, and the amount of plant food provided will consequently be less than when upon short-branched trees, with a comparatively large amount of sap wood, since the fruit buds are formed on the last year's growth. When the heading-back method is used much can be done toward the thinning of the fruit, and, for that reason, it should be delayed as long as possible in order to obtain a correct idea of the condition of the buds, and thus prune judiciously. If all of the buds have been destroyed, the last year's growth should be headed back severely, leaving only one or two strong buds, in this way keeping the trees in as compact a form as possible. If only a few scattering fruit buds are alive, only the ends of the shoots should be cut back, thus leaving

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practically all of the buds to develop, but, on the other hand, if most of the buds are alive, the shoots can be cut back one-half or two-thirds and thus about one-half of the work of thinning the fruit will be saved. While

FIG. 4.—PRUNING BY THINNING OUT.

it is best to prune before the trees blossom, the pruning cannot be used to thin as judiciously as when delayed until it can be determined how much fruit has set.

CROTCHES.

If there is any rule that should be uppermost in one's mind when pruning, it is "avoid crotches," as whenever two branches of about equal size form a fork it can be put down as absolutely certain that in time one, or both perhaps, will break down. If possible, one of the shoots should be cut out while small, but if they occur in large trees it will be safer to cut one of them out and head the other back, so as to cause it to send out side branches than to leave it to break down the tree. In case the pruning has been improperly done and a tree divides above its trunk into two branches of equal size forming a distinct crotch, so that the symmetry would be greatly injured by cutting out one of them, both can sometimes be saved by clamping them together by means of a bolt, thus relieving the crotch from any strain.

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CROSSED LIMBS.

A second thing to have in mind is to remove all branches that seem likely to interfere with each other. Although it is less common than in the cherry and pear, the branches of peaches cross each other and become partially girdled by the chafing that ensues. As soon as they show any tendency to cross each other, the one that can best be spared should be cut out. While it is desirable to have the head thick enough to keep the sun from burning the bark of the limbs, and to have the main branches clothed with fruiting shoots back to within four or five feet of the main stem, the mistake must not be made of keeping the heads so thick that the sun cannot get in to color the fruit. When well laden, although some of the centre shoots may maintain their upright position, the side branches will be sometimes drawn down by their load of fruit and the sun can thus get down among the branches. If, however, the branches are so thick as to prevent this, some of the weaker ones should be cut out, in addition to the heading back that is given the others. A pair of pruning shears will be all that is needed for the removal of the surplus branches if the work is not neglected. However, although its excessive use will shorten the life of the tree, a saw must sometimes be resorted to. Whatever method of pruning is employed, the cuts should be as smooth as possible, care being taken not to bruise the bark, or tear it down the stub. While no general rule can be given for the place of making a cut, it can be said that, when cutting back a branch to the main shoot, care should be taken not to leave any projecting spur and the wound should be as small as possible.

As a rule, the cut should start from an eighth to a fourth of an inch from the main branch and come out in about the middle of the thickening which is generally present on the under side. When made parallel with the main branch the wound is unnecessarily large, and it is better to have it made 10 to 15 degrees from a parallel. In heading back a branch the cut should be made at an angle of 45°, just beyond a strong bud or branch.

THINNING THE FRUIT.

One of the most difficult things about peach growing is to have the trees properly thinned, as few men without previous experience will remove enough of the fruits even if those left upon the trees are properly distributed. Not only will there be as many bushels of fruit upon a properly pruned tree, as on one that has twice or three times as many fruits, but the peaches being larger and handsomer will sell readily at a highly remunertive price, while others of the same variety, that have been given exactly the same care except that they were not thinned, will be a drug in the market at any price and may not bring enough to pay charges. It is extremely unprofitable not to thin the fruit and it will also be found a short-sighted policy, as the trees will be greatly weakened by the strain of supplying the phosphorus and other mineral elements required for the formation of the excessive number of pits. The large, thinned fruits contain only perhaps one-third as many pits as the others, being largely composed of the flesh which is mostly water. The mineral elements are most likely to be wanting in the soil, and are consequently most difficult to obtain; since they are required in large quantities in the pits, it can be readily seen that the practice of leaving the fruit unthinned is very exhausting to the trees and will so lessen their vitality that the growth will

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be checked and future productiveness lessened. If a tree is left unthinned and, particularly if the summer is a dry one, it often attempts to relieve itself by dropping part of the fruit, and as they are somewhat loosely attached a heavy wind-storm may strew the ground with the half-grown peaches, oftentimes taking nearly the entire crop. While the trees would have been more likely to retain the fruit had they been thinned, there would also have been a much less serious strain to the tree, as the small number of pits formed would take less mineral food. In some seasons the fruit drops badly soon after it has set, from the effects of curculio, curl, extremes of moisture or other causes, and for this reason the thinning should be delayed as long as possible without drawing on the trees too much. If done just before the pits begin to harden, as a rule there will be little loss from dropping after that time. The fruit will be about the size of a natural peach pit, and it will be early enough to avoid a strain to the trees. The time will vary with the season but, as a rule, the 12th to 18th of June will answer in southern Michigan and the 15th to 25th in the northern half of the State. In localities where the rose chafer is troublesome, it will be well to at least delay the final thinning until danger from them is over. In thinning the fruit, no set rule can be given, as it varies with the size and vigor of the tree, the variety, and with the amount (if any) the tree has been headed back. The old rule, when trees were not headed back, was to leave a peach every six inches upon the branches, and it is a safe rule to follow under those conditions, but when the fruit has been partly thinned by heading back it will not answer.

If evenly distributed over the tree, and when the branches are clothed with soft spur-like branches, it will be well, as a rule, never to leave more than two peaches upon any branch unless it is long and unusually strong, and not to have them under any conditions nearer than four inches from each other. On the other hand, if the side branches are not numerous, and if the shoots are cut back very severely the distance may be somewhat lessened and the number increased. In thinning, an effort should be made to leave the peaches as evenly distributed as possible, making due allowance for the size and strength of the branches. The larger fruits and particularly those near the base of the shoots should be left and the others removed. With a little experience, a tree can be very readily thinned, particularly if it has been well headed back, which as noted before will greatly reduce the number of peaches that need to be removed with the hand, and by lessening the height, render the operation much easier, as most of the work can be done from the ground. The length of time required to prune a tree varies to such an extent with the size and height of the tree and with the number of fruits to be removed that no estimate of the expense can be given. It can be safely said, however, that the cost will be several times repaid, to say nothing of the benefit to the trees. If when thinning the trees the peaches are thrown into a basket and burned, a great number of curculio will be destroyed and future attacks lessened. When peaches are properly thinned the danger from rot will be decreased, as it is a common occurrence to have one diseased peach transmit the rot to all others in contact with it, and when crowded together the rot will be much more likely to appear, than when the fruits are arranged singly.

MANURES AND FERTILIZERS.

So much depends upon the condition and natural fertility of the soil that only general rules for the application of manures and fertilizers can

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be given. If the soil is in condition to furnish a good clover sod to be turned under no better preparation can be furnished, and frequently it will supply plant food until the trees come into bearing. If the clover sod cannot be secured, and if the soil is not rich enough to grow a good crop of corn, some manure or fertilizer should be applied. The application of ten tons of decomposed stable manure broadcast, before the land is dragged in the spring, will supply food for the growth of the trees and for the crops that may be grown between them; a method of supplying food to the trees, without feeding the other crop and by the use of a comparatively small amount of manure, is to spread three or four forkfuls, evenly over spots four or five feet in diameter, where the trees are to be planted. In any case, it should be incorporated with the soil and not allowed in contact with the roots. While the application of stable manure is advisable for the young trees upon poor soil, rather better results in some respects can be obtained when they are of bearing age, particularly upon soil that contains a fair amount of organic matter, by the use of the so-called mineral fertilizers. It is known that if we supply plants with potash, phosphoric acid and nitrogen they can, as a rule, obtain the remaining elements needed for their growth from the soil and atmosphere. The nitrogen is necessary for all growth of plants, but if present in excess it is likely to cause a soft, watery growth. It is generally present in sufficient quantities in soils of fair fertility to carry the trees up to the bearing age, provided the soil is not robbed of its fertility by other crops. Phosphoric acid is also found in all parts of plants, but is particularly abundant in the seeds, and as soluble phosphoric acid is gradually removed from the soil by successive crops there are few bearing orchards that will not be benefited by its use as a fertilizer. We have at hand materials that supply these elements in a concentrated form, at prices no higher than would be the cost of the more bulky stable manure, when it has to be hauled any distance.

One of the best fertilizers for orchards will be found in unleached wood ashes. They contain all the elements needed for plant growth, except nitrogen, and these are present not only in about the proportions needed by the trees, but they are in combinations that can be readily taken up by them. A good sample of wood ashes should contain about three to five per cent of potash, and one and one-half per cent of phosphoric acid; if they have been leached or washed by rains the amount will be considerably reduced, while in some cases the amount of both potash and phosphoric acid is fifty per cent larger than is given. From a half peck to a bushel of wood ashes per tree, according to the size, can always be used to advantage, and if the trees are large, so as to cover the ground, it will be best to use from 100 to 150 bushels per acre scattered broadcast, covering the entire ground, Since ashes tend to render a clay soil still more tenacious, care should be taken that they are not applied in large quantities upon stiff soils.

Among other sources of potash are the German potash salts, which are imported as muriates and sulphates, and contain varying proportions of chloride of sodium (common salt), and chloride of magnesium. The best grades contain about 50 per cent of potash, and are preferable to the cheaper ones, as the expense of transporting the worthless materials in the lower grades makes the potash cost more per pound than in the higher grades.

From one-half pound to three pounds per tree, or from fifty to three hundred pounds per acre, should be applied, taking care it is not brought in too close contact with the roots. In soils deficient in potash it must be applied

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to secure a proper development of the trees and it will also increase the amount of sugar and heighten the color of the fruit.

The best source of phosphoric acid is from bones, either ground, or as bone charcoal. The value of ground bone depends to a considerable extent upon its fineness, and the action will be hastened if it has been treated with acid and rendered soluble, in which case it forms what is known as a superphosphate. Fresh bones contain a small amount of nitrogen which adds to their value. A fair sample of ground bone should contain rather more than 20 per cent of phosphoric acid, of which about one-third can be utilized by plants; while the remaining 15 per cent is in an insoluble form it will gradually become available. The amount of nitrogen in ground bones is quite variable but is seldom less than 2, or more than 5 per cent. In addition to the fresh bones, bone charcoal in the form of dissolved bone-black is also used as a source of phosphoric acid, it containing some 16 to 20 per cent, nearly all of which is immediately soluble. Nitrogen is not present in bone-black, having been removed by the burning. Phosphoric acid is also obtained from various waste products of slaughter houses, from guano and fish scraps and, in less valuable forms, is mined at Charleston, South Carolina, and in Florida, and is found in iron slag. The Charleston phosphate rock is largely used in fertilizers, but its phosphoric acid is less valuable than that from bones. The iron slag phosphate, sometimes known as "Odorless" is highly commended by many who have tried it; although it has some value, the extravagant claims made for it can hardly be sustained. Analysis shows that it contains about 20 per cent of phosphoric acid, of which some 3 to 4 per cent is soluble.

The nitrogen supply, except as furnished incidentally in the bones and waste animal products, is obtained from nitrate of sodium, and sulphate of ammonium. In both of these salts it is readily soluble and is considered more valuable than when from other sources. The quantity of the salts required varies with the character of the soil as well as with the age of the trees. Stable manure is preferable as the source of nitrogen, but if it cannot be obtained and the condition of the soil is such that some form of nitrogen is needed to give a fair growth to the trees, 100 to 150 pounds of either of these chemicals per acre would generally be ample, while a considerably smaller quantity would suffice for young trees. There is much danger if it is used in large quantities, particularly if it comes in close contact with the roots. One can determine the relative value of the various fertilizers as their guaranteed analysis must be furnished, and with this and the value per pound of potash, phosphoric acid and nitrogen it can readily be computed. Potash is reckoned as worth about 6 cents per pound when in the form of sulphate and five cents as a muriate. Phosphoric acid when soluble is valued at eight cents, reverted at seven, and when insoluble in bones it is valued at from three to seven cents, while in rock and similar materials it is only worth from one to two cents at the most, while from some materials it has little if any value. The variation in the value of nitrogen is still greater, as in nitrate of soda it is worth sixteen cents per pound; as sulphate of ammonia eighteen cents; in blood, meat and fish scraps fifteen cents; in bones from ten to fifteen cents according to the fineness of grinding. In stable manure nitrogen would be worth about eight cents per pound. As they are for the most part readily soluble it is best to apply the fertilizers in the spring; if this is done just before the land is to be harrowed it will be better than to plow it in. In seasons when

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droughts prevail there is less effect from fertilizers than from stable manure, but, although there may be some loss of the nitrogen and potash, the phosphates will be retained in the soil with little or no loss.

THE RATIONAL USE OF FERTILIZERS.

As nearly all, if not quite all soils contain a considerable amount of lime there will be little use in applying lime in any form for the sake of supplying that element to plants, and the same can be said of sodium and chlorine, and as these elements make up our common salt, it will be seen that salt is of no value to any crop as a fertilizer. Of the three elements mentioned above that are often deficient in the soil, potash, phosphorus, and nitrogen, it can be said that a rich virgin soil will generally contain all that is needed for an orchard, but after the trees have matured several crops of fruit, the available potash and phosphorus is likely to become so reduced that a satisfactory growth cannot be obtained, and if the soil is in any way deficient in organic matter, the amount of nitrogen will probably be rather small. In order to determine what one of these elements and the amount that should be used, it is well to make use of them experimentally, applying, for example, ground bone upon one row of trees, muriate of potash, or wood ashes upon an other, nitrate of soda, if the land is poor, upon a third, and combinations of two and of all of these materials upon still other rows, with a proper number of untreated rows. If the plots have been properly selected, one should be able to tell at the end of the second or third year which of the elements are needed, and if the experiment has been carried on so as to have plots with different quantities of the fertilizers upon them the amount that can be properly applied to each can be learned, and in this way one can be saved the useless application of fertilizing materials that are, perhaps, already in excess in the soil. As a rule, where no experiments of the kind have been conducted, a bearing orchard should have, once in two years, from 300 to 500 pounds of ground bone, 200 to 300 pounds of muriate of potash (instead of the muriate of potash, 100 bushels of wood ashes if unleached, or 300 bushels of leached may be used); 150 pounds of nitrate of soda, or 25 tons of decomposed stable manure, will be beneficial if the soil is light. In addition to their value for supplying plant food, the chemical fertilizers have an additional value, that is perhaps equally important, as, by supplying soluble plant food early in the season, they enable trees to make their growth during the first of the season and ripen their wood thoroughly before winter. The growth is, as a rule, much more firm than that obtained by the use of stable manure, or from the natural fertility of the soil. In fact the chemical manures can be used as correctives since if those containing potash and phosphoric acid are added to soils that have been highly enriched with stable manure, or that are naturally quite rich in organic matter, they will have a tendency to make the new wood more firm and compact. It can then be claimed that the proper use of chemical manures will increase the hardiness of the trees, and will both render the fruit buds less susceptible to sudden changes in the weather, and lessen the danger of their winter-killing.

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THE NURSERY CULTURE OF THE PEACH.

While the farmer or village resident will prefer to purchase his peach trees of a nurseryman, it often happens that an extensive grower can at a slight cost in labor, propagate his own trees and thus be more likely to secure the varieties he desires to plant, and to have them free from all taint of disease. There are no secrets in the nursery growing of peach trees that cannot be readily acquired by any one, and, although practice in the various operations will necessarily make one more expert, if the instructions here given are carefully followed any intelligent person can grow peach trees.

SOIL FOR A PEACH NURSERY.

Peaches need about the same kind of soil, whether in the nursery, or in the orchard, although the nursery soil should be rather more fertile, and for propagating peach trees a well-drained, sandy loam should be chosen. A clover sod plowed under is an excellent preparation of the soil, and if the soil is naturally fairly fertile it will need no other dressing. If stable manure is used, care should be taken that it is not applied in excessive quantities, or in an undecomposed condition, as it would probably cause a watery growth that would not ripen, and winter-killing would ensue. If any fertilizer is needed, unleached wood ashes at the rate of 150 bushels per acre, and about 500 pounds of ground bone, will supply the necessary plant food, in anything but an exhausted soil, and a strong, well ripened growth can be obtained. If these are not used and if the soil is deficient in organic matter ten or fifteen loads of decomposed stable manure, spread broadcast and plowed in will greatly aid in growing good stock. As stated above a good clover sod plowed under will be preferable, as it will not only supply the necessary plant food to the soil but it will improve its physical condition. The land should be carefully fitted, as time expended in this will be doubly repaid by the amount saved in the after cultivation.

THE SEED AND ITS PREPARATION.

As in the growing of all kinds of nursery trees, the first thing is to obtain suitable stocks upon which to work the improved varieties. As stock for this fruit, peach seedlings are almost universally used. The plum is preferred as a stock for the peach by the English, when they have a cold, wet soil, and is recommended by some for use under similar conditions in this country, but it is doubtful if there are any soils, or localities, in which peaches can be relied on to fruit, where the plum stock is necessary. Nearly all writers advocate the use of natural pits, or those from seedling peaches, and this is the almost universal custom. The claim is made that seedlings grown from natural seed are more vigorous than from seed of improved varieties. The natural seed owes its value to the fact that all the efforts of plants in a wild state are used in perpetuating themselves, while our cultivated varieties have been so modified by man in his endeavor to increase the amount, or the quality of the flesh surrounding the stone, that the reproductive properties in the seed itself are weakened, the seeds will be less certain to grow, and the trees will be

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less vigorous, less hardy, and consequently shorter lived. At any rate as nearly all of the natural seed comes from Virginia and Tennessee where the "yellows" are not known to be, there will be less danger of obtaining the germs of this disease in them, than when pits of improved varieties are used, unless one is familiar with the source from which the seed comes. The pits from canning factories that obtain their fruit from infected districts should be looked on with suspicion. The natural seed can readily be distinguished from that of the improved varieties, as it is smaller, more nearly spherical and lacking the wing that is so noticeable around the edge of the latter; the canals upon the surface of the pits also, are not as large, or deep as in the latter; the halves of the shell are more firmly united and the kernels are firmer and thicker. The pits should, if possible, be obtained in the autumn and although they may at once be planted in nursery rows, it is not the best plan as the pits thus treated are not all of them sure to germinate the first year, if at all, and an uneven stand will result. It frequently happens that when thus treated, part only of the pits sprout in the spring, others appear the following year, and still others may show themselves the third year from planting.

STRATIFYING THE SEED.

In order to secure the prompt germination of the pits, they should be so treated that they are exposed to the action of frost. If only a few are to be planted, they should be placed in thin layers, alternately with an inch or so of soil, in boxes, and after that closed up so that the moisture cannot escape, and placed on the north side of a building where they will be out of the way of the drying influence of the sun. To secure the full action of the frost the seed should be soaked for twenty-four hours before being placed in the box, and it will be well to thus treat the seeds, however they may be stratified. When nurserymen stratify large quantities of seed much the same course is pursued, except that they excavate a trench, ten inches deep and large enough to hold the seed, in some moist but well-drained soil. In this the seeds are placed in alternate layers of soil to a depth of eight inches and covered with two inches of sand. Unless the soil is moist it will be found well to wet the bed down thoroughly before covering it up. Another method is to spread out the seeds upon the surface to the depth of three inches, and then spade them in, taking pains to have them all covered. Treated in either way they will be exposed to the freezing and thawing of Winter and the shells will be so loosened that as the seeds swell in the Spring most of them will fall apart. When the time for planting comes they can be taken out, separated from the soil by means of a screen, and all that have not opened carefully cracked with the hammer. When an even stand is desired and especially in localities where moles are troublesome, another method of stratifying will be found still more reliable. The pits are scattered on the surface in a single layer, forming a bed four feet wide and of the necessary length, and covered with two inches of soil. In the Spring they will be so well cracked that most of them will sprout and send up shoots; as soon as they are three or four inches high they should be carefully taken out and transplanted with a dibble to the nursery rows at intervals of eight inches, placing them so that they will be about two inches deeper than they were in the seed bed. By keeping the plants in pails of water, so that they

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will not wilt, very few will be lost if the soil is moderately moist. If the season is very dry it may become necessary to water the plants once or twice.

PLANTING THE SEED.

In case the seed is planted in the fall, or in the spring before it has sprouted, the operation is not unlike the sowing of peas. Drills are made with a marker, or with a hoe if only a few are to be planted, two inches in depth and at intervals of about three feet eight inches, being rather more in rich soil and less in sand; in this the seeds, which have been previously cracked, are dropped about four inches apart. They should then be covered with a hoe or rake and the soil firmly pressed down, using a roller in light soil. From eight to ten bushels of natural seed will be required per acre and with good success this should give twenty thousand trees; as a rule, however, not over ten thousand first-class trees will be obtained from an acre even under the best of conditions. In laying out the nursery, it is preferable to have the rows run north and south and space should be left at each end to give room for turning in cultivating. During the first part of the season, the young seedlings should be cultivated once in ten days and the soil between the plants occasionally stirred with a hoe to keep the weeds down and a crust from forming. The cultivation should be shallow and with an implement with small teeth or shovels. About the first of August it will be well to go over them and rub off the leaves to a height of four or five inches on the stem. In case the season is dry, the cultivation should be more frequent, and if it looks, by the middle of July or the first of August as though the stocks would not reach a suitable size for working, they can be aided by scattering broadcast along the rows, ground bone at the rate of three hundred pounds per acre and a bushel of wood ashes to eight or ten rods of row. Instead of the above, guano or superphosphate could be used. Nitrate of soda is also excellent to promote growth but it should be used very carefully at the rate of not over 100 pounds per acre. They should be thoroughly worked into the soil. If conveniences for watering are handy it will pay, if the drought continues, to give the plants a thorough watering, which will help to render the fertilizer available.

By the last of August the smallest of the seedlings should be as large as a lead pencil and the others will range from that size to a half or five-eighths of an inch in diamater.

BUDDING.

As the object of this operation is to obtain trees of certain desirable varieties, every precaution should be taken that the buds used are true to name. As a rule, they are more reliable if taken from bearing trees, but they are not as vigorous, or as easy to obtain as from nursery trees. If buds from small trees are used, especial pains should be taken, as a mistake with a single bud may make a difference with a hundred or more trees when buds are taken the following year. The buds, above all, should be healthy, plump, and well ripened; as a rule those at both the upper and the lower ends should be rejected. After cutting the bud sticks, the leaves should at once be cut off, leaving the leaf stems about three-eighths of an inch long, as handles to use in inserting the buds; to keep them from drying they should be wrapped in oiled cloth.

As a rule, the budding can be done as soon as the stocks are of a suit-

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able size, and when the buds have become firm, but if the growth of the stocks is still very rapid it will be well to delay the operation, as a too vigorous growth may throw out, or cover up and smother the buds. The budding should be completed ten days or two weeks before growth stops, and while it can be performed with good success as late as the first week in October, it is better to have it finished by the middle of September. If the budding is performed early in the season and the period of growth is long, the buds may start into growth and be injured by the winter. In addition to the seedling stocks and cions of the desired variety, the only materials required in budding are a budding knife, and something for binding the buds. The budding knife (Fig. 5, *a*), has a thin, sharp blade with its end rounded so that the point is even with the back. To assist in opening the bark there is either a thin piece of ivory in the other end of the handle, or the tip of the blade may be rounded so as to make it blunt. As a wrapping material raffia, which is obtained in narrow strips from the epidermis of the leaves of a certain kind of palm, is most commonly used, although

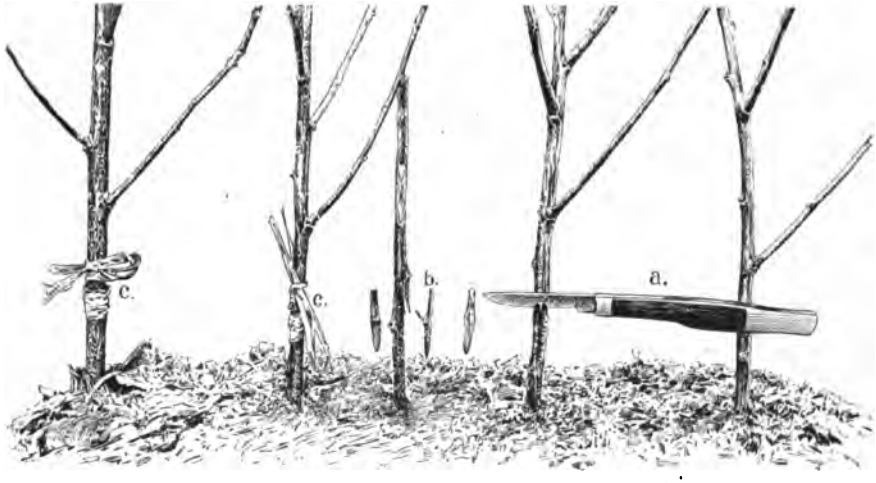

FIG. 5.—BUDDING.
a, Budding knife. *b*, Bud-stick and buds. *c*, Bud inserted and wrapped.

the bast layer of bark of the basswood and yarn are preferred by some. The operation of budding consists in making a T shaped cut in the bark of the stock and, after lifting the bark, placing under it a bud from the cion with a little bark attached and binding the bark firmly down upon it. The cut is made within three or four inches of the ground drawing the knife either vertically or horizontally first, as is most convenient. In case the horizontal cut is first made, the knife should be drawn upward to the cross cut when making the vertical incision, and when the two meet a slight twist of the wrist will cause the knife to turn up the edges of the bark so that the bud can be easily inserted. If the horizontal cut is made last, it should be at a slight angle (Fig. 5, *a*) so that the corners of the bark will be somewhat raised from the stock. If the stocks are in proper condition for budding, the bark will be sufficiently raised, to readily admit of the insertion of the bud. If for any reason the bark does not lift, the ivory at the end of the handle, or the rounded end of the blade of the budding knife, can be used to open it. Having made the

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stock ready for a bud, one of the bud sticks (Fig. 5, *b*) should be drawn out from its wrapping and a bud (Fig. 5, *b*) removed. In cutting the bud the cion is held in the left hand, resting on the forefinger, with the small end toward the body. The knife is inserted about half an inch below the bud and a cut is then made deep enough to take off a thin shaving of the wood and extending one-half inch above the bud. The cut may be brought out through the bark at this point, entirely severing the bud, but this is likely to cause the bud to fall to the ground. The usual custom is to remove the knife and complete the severing of the bark, by a cut at right angles to the one first made. The shaving of wood taken off with the bark is removed by some budders, but it is not necessary and is sometimes harmful, unless carefully done, as the base of the bud may be torn out with the wood. Then take the stub of the leaf stalk, left for the purpose attached to the bud, between the thumb and forefinger of the right hand and insert it in the slit in the bark of the stock, crowding it down until the top of the bark attached to the bud is below the horizontal cut on the stock. If still loose, it is well to push it down until the bark of the stock presses firmly against the piece of bark attached to the bud. The bud is now ready for tying, which consists in wrapping a strip of raffia or other material that is to be used for the purpose, from twelve to fifteen inches in length, according to the size of the stocks, and from one-fourth to one-half inch in width, from two to four times around the stock beneath the bud, and about twice above it (Fig. 5, *c*), giving it tension enough to press the bark firmly down upon the bud. This pressure of the bark is beneficial in two ways, as by shutting out the air it prevents the bud from drying out, and by bringing the bud and stock in close contact the union is more rapid. The operation of budding is now completed but the tree is by no means ready for the orchard. In about ten days or two weeks the trees should be looked over and if any of the buds have failed to take, new ones can be inserted. In all cases where the buds have taken, the bands should be cut, by drawing a knife across them on the opposite side of the stock from the bud. If one of the folds is cut it will be sufficient, as the wrapping will open of itself. Sometimes the growth of the stock before the bud has taken is so rapid that the pressure of the band will so check the flow of the sap that, if left to itself, the stock would be girdled. Upon all such stocks the bands should be loosened and retied. In case the budding is done towards the close of the season of growth, it is not always necessary that the bands be cut, as there is no danger of constriction and they will decay before spring, but under other conditions it is safer to be sure that the bands are cut. Nothing further is necessary the first year, unless the trees are on rather moist soil, where there is a good deal of freezing and thawing, in which case it is well to throw up a light furrow, on each side of the rows, covering the buds. In the spring this should be thrown away from the rows and the narrow strip between the trees drawn away with hoes. The stocks should then be cut back, the cut being made somewhat slanting, beginning on the side opposite the bud, about half an inch above the bud itself, and giving the top of the stub a slope of about 45 degrees. Sometimes the cut is made several inches above the bud and, later on, after the bud has sent up a stem twelve or fifteen inches high, the stub is cut back near enough the bud to admit its being readily grown over. Cultivation should begin as soon as the soil is in a suitable condition and should be kept up through the Summer until the trees get large enough to shade the ground. In case the season is a

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dry one, or if the trees make a slow growth, it should be kept up until the middle of August, using a fine toothed, shallow-working implement. When growth starts, a number of suckers will start up from the stub of the stock. When they get to be two inches long they should be rubbed off, taking pains to remove every portion. As a rule no others will come out but if they make their appearance, they should be promptly removed. The hoe should be used this season sufficiently often to keep the crust between the trees broken. The trees will be of a suitable size for orchard planting in the fall or following spring.

By the first of November, or earlier if most of the leaves have fallen, the trees can be dug. In doing this pains should be taken not to cut the roots too short, as this would lessen the chances of living, and at best will shorten the growth the first year.

JUNE-BUDDED TREES.

In some sections what are known as June-budded trees are grown, but they are of little value except as a means of rapidly propagating new sorts of which buds were not set in the fall. The cions must be cut in the fall, or winter, and kept dormant until the stocks have begun to grow so that the bark will lift. When the buds are set, most of the top is cut off and in two or three weeks the stock is cut back to the bud, which soon breaks and forms a weak growth. In the south the method is used with fair success, but in this State it has few advantages and several disadvantages, the principal one in addition to the weakness of the growth, being that it is likely to make a late growth and be injured by the winter.

THE CULTIVATION OF THE PLUM.

During the past ten years the plum has come rapidly to the front as a desirable fruit for the commercial grower. The success met with by the people of Oceana county in the cultivation of this fruit, and the highly remunerative prices obtained have led to its being largely planted in various sections of the State, and the returns thus far obtained from the earlier plantings, have been very generally satisfactory.

There are many sections of the State in which this fruit can be grown, where the peach will not thrive, and it will undoubtedly greatly increase in value as a commercial fruit.

While the care required by a plum orchard differs in some of its details from that needed by the peach, the general principles upon which we work are the same; we shall therefore treat the subject of plum growing largely by referring the reader to the preceding pages upon peach culture, and merely pointing out the particular points in which the treatment given to the plum should differ.

SOIL AND CLIMATE FOR THE PLUM.

The climate of Michigan seems well suited to the plum, and it is a sure crop in all parts of the State except in some of the interior counties in the

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extreme northern part of the lower peninsula and in portions of the upper peninsula, but even there the failure is due more to soil than climatic conditions. While the same general rules regarding elevation and exposure apply to this fruit as have been given for the peach, they vary in degree, and plums can, owing to the greater hardiness of the fruit-buds as well as of the trees, be grown in locations where the peach will fail. In fact it is a common practice, when large areas are planted to these fruits upon rolling land, to use the higher portions for peach trees and to set the plums in the depressions, although if the soil is suitable the plums would do better upon the elevated land.

As a rule it may be said that plums need a strong and rather heavy soil, but on the contrary the most successful plum orchards in the State are in Oceana county, where the soil is light. The soil there, however, is rich in lime and seems well adapted to the growth of the trees and to the production of large crops of fine fruit. For the best results the land should be fairly moist, but success cannot be obtained if it is not well drained. If moisture is present with a proper supply of plant food, fair success can be obtained upon almost any soil, although a light sand, muck or heavy clay should be avoided, with a moderately heavy loam either sand or clay as a choice.

AGE, SIZE AND CARE OF TREES.

In a general way, the same rules apply here as were given for the peach. The ordinary planter will, however, find trees that have been grown in the nursery two years from the bud, preferable to one-year trees.

It may be well to state that plum trees are generally budded upon Myrobalan stocks, (another name for *Prunus cerasifera*, a dwarf European plum). The peach is sometimes used as a stock for American varieties, and is recommended by some nurserymen as a stock for European sorts on sandy soils. Sometimes St Julien stocks are used, and others grown from cuttings of the Marianna (a Texas variety with close affinities to *Prunus cerasifera*), are meeting with favor. The first two kinds may be grown from imported seeds, but it is a more comman plan to plant European grown stocks. They are placed about three feet eight inches by six inches, and if strong may, under favorable conditions, be budded the same season. If not large enough, budding may be delayed until the following year. The season for budding the plum is earlier than for the peach, the operation being performed as a rule either the latter half of July or the first half of August. Other than noted the care of plums in the nursery is the same as for the peach.

In heading back the top of the trees at the time of planting, the common practice differs somewhat from the method pursued with the peach. According to the amount of growth and the amount of root area the branches are cut back from one-half to two-thirds, and the weaker ones are thinned out so as to leave not over five side shoots in addition to the leader, which should be shortened only about one-third. The branches should be distributed upon the different sides of the stem as evenly as possible, taking pains also to secure a vertical distribution. Both extremes should be avoided in fixing the height for the head; three feet from the ground to the lower branches may be taken as an average, although many would have that as the maximum, and under some conditions it would be preferable to a greater height.

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The after pruning is confined to the thinning out of unnecessary branches, particularly those showing a tendency to rub against others, and the heading in of rampant shoots. The extremes of either heading in or thinning out as practiced upon the peach do not apply to the plum. A plum tree properly pruned at the time of transplanting will need but little training thereafter and that given should be the least that will suffice to guide it into a symmetrical form.

As is the case with all other fruits, the plum needs thorough cultivation if we would obtain the best results. There is even greater need of fertilizers than with the peach, as the plum does not seem to be as good a scavenger as does that fruit, but if possible it should be in some mineral form. Stable manure can, however, be used under some circumstances to improve the physical condititions of the soil, its effect either upon a light or heavy soil being beneficial.

VARIETIES OF THE PLUM.

Nearly all of the varieties commonly in cultivation belong to the so-called European species, *Prunus domestica*. The better kinds are as follows, arranged in the order of their ripening:

Duane's Purple.—Tree vigorous, shoots very downy, leaves large and downy. Fruit very large, oblong-oval, one side larger than the other. Stem slender, three-fourths of an inch long, set in a narrow cavity; color red-purplish, red in the sun, dotted with yellow and with a lilac bloom; flesh light yellow, juicy, rather sweet; adheres slightly to the stone even when ripe. Ripens the middle of August. A profitable market sort.

Washington (Fig. 6).—Tree strong growing, forming a round head, leaves large and glossy, branches light brown, downy. Fruit quite large, roundish-oval, suture slight. Stalk five-eighths of an inch long, stout, downy, set in a shallow but wide cavity. Deep yellow with crimson blush and dots, marbled with green before ripe. Flesh yellow, firm, sweet and rich, free. Last of August. One of the best yellow plums.

Bradshaw (Fig. 6) (*Niagara*).—Tree very vigorous, with large, purplish and smooth shoots. Fruit large, ovate, with a stout stem three-fourths of an inch long, slightly inserted in the narrow cavity, sometimes with a slight neck; purplish red with a blue bloom. Flesh yellowish, becoming brownish yellow, rather coarse, but juicy and pleasant. Clings slightly to the stone until fully ripe. Last of August. One of the best of the standard varieties, although the new variety, *Field*, which in many respects resembles it, is preferred by many as it is one or two weeks earlier.

Green Gage (*Reine Claude*).—Trees small, slow growing, smooth shoots, buds with well marked shoulders. Fruit small, with slight suture, round, green or yellowish green, mottled with red in the sun when fully ripe. Stem slender, one-half inch long, slightly inserted. Flesh light green, rich, melting, juicy, luscious, free. The best in quality of all plums. Last of August and first of September.

Lombard (Fig. 6).—Tree vigorous with glossy, purple shoots, leaves crumpled. Fruit of medium size, oval, slightly flattened at the ends, suture indistinct, violet red, with thin, white bloom. Stalk slender, five-eighths of an inch long. Flesh, deep yellow, juicy, pleasant, adhering to the stone. Early September. One of the most productive varieties. While it should be in every collection, the immense number of trees of this variety that have been planted within the past five years will tend, by lowering the

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price, to make it less desirable for planting upon a large scale as a shipping variety.

Jefferson.—Fruit large, oval or slightly obovate with faint suture, golden yellow with reddish blush, and thin white bloom. Stalk stout, one inch long, but slightly inserted. Flesh, deep yellow, juicy, melting and of high flavor, free from long-pointed stone. One of the best dessert plums. First part of September.

Prince Englebert (Fig. 6).—Tree vigorous; branches smooth, downy. Fruit large, oblong-oval, deep purple with brown dots and blue bloom. Stalk medium with a swelling at the base, set in a deep, narrow cavity. Flesh greenish yellow, juicy, sweet, and of good flavor, free, Early September.

Geuii (Fig. 6).—Tree strong, vigorous, spreading, an early and abundant bearer. Branches stout, smooth, grayish brown. Fruit large, oval, slightly pointed at both ends, suture slight if any; dark purple with thick bloom. Stem long and slender inserted in a deep broad cavity. Flesh light yellow, rather coarse, firm, sweet when fully ripe, free. Middle of September. Excellent for shipping.

Imperial Gage.—Trees upright and fairly vigorous, shoots long and dark, downy. Fruit of medium size, oval with distinct suture. Stalk one inch long, moderately stout, set in a slight depression. Skin pale green becoming yellowish with a distinct marbling of green stripes. Flesh greenish yellow, juicy, rich and melting, generally free from oval-pointed stone. Quite productive. September. Excellent for both table and market.

Pond (Fig. 6) (*English*).—Tree very vigorous; branches grayish and smooth. Fruit large, oval with distinct neck, reddish violet with a thin white bloom, and dotted with brown spots. Flesh yellow, rather coarse, but juicy and sweet. A very showy fruit, quite desirable for market. Middle of September.

Quackenboss (Fig. 6).—Tree, a strong, upright grower, shoots smooth. Fruit of large size, oblong-oval, deep purple in sun, with reddish spots, dark amber in the shade, stalk short, suture indistinct. Flesh yellow, rather coarse, sweet and juicy. Quite productive and a valuable market sort. Middle of September.

German Prune.—Shoots smooth, slender. Fruit large, oval, swollen on one side, tapering particularly toward stem, suture well marked. Skin purple, with dense bloom. Stem slender, three-fourths of an inch long, cavity shallow. Flesh greenish yellow, firm, sweet, free; stone flat, slightly curved. Used for preserving and drying. Middle to last of September.

Damson (Fig. 6).—Tree small, branches slender and thorny, subject to the black knot. Fruit small, oval, depressed, purple with a dense blue bloom, stem slender. Flesh melting and juicy, a partial cling, quite acid. September.

Shropshire Damson.—An English variety. Blue with a thin bloom, oblong or obovate, of rather better quality than the common Damson. Useful for preserves. Last of September, and October.

Coe Golden Drop.—Tree moderately vigorous and quite productive, smooth. Fruit large, oval or obovate, with a slight neck, unequally divided by a well marked suture. Light yellow or greenish yellow with red dots on cheek. Stem seven-eighths of an inch long, quite stiff. Flesh firm, yellowish, adheres to stone, juicy, sweet, excellent. Last of September, and October. Where it ripens it is one of the best late plums.

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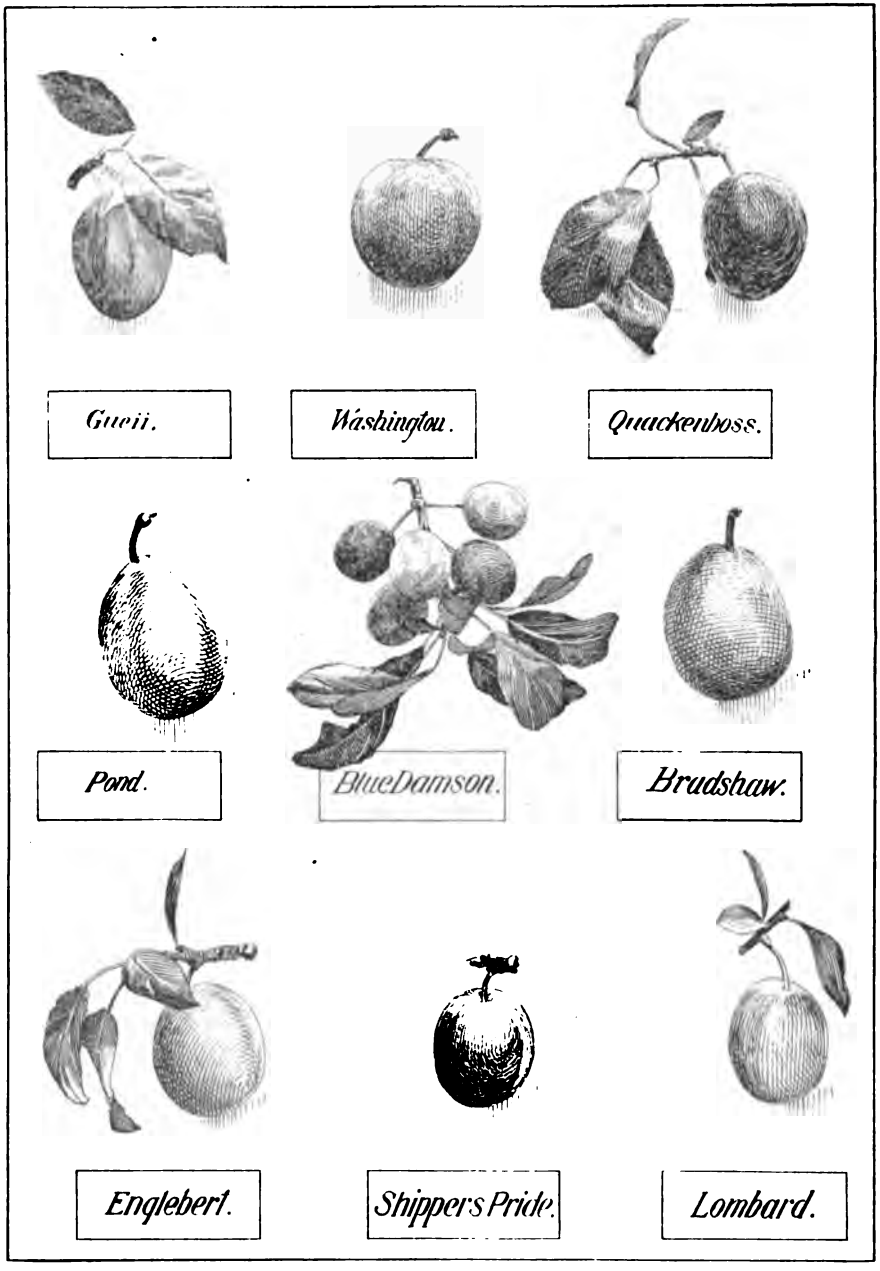

FIG. 6.—VARIETIES OF PLUMS.—(*One-third natural size*).

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Fellemburg (*Italian Prune*).—Tree slender. Fruit of medium size, oval, tapering to both ends. Dark purple with a dark bloom; stem in a shallow and narrow cavity, slender, one inch long. Flesh greenish yellow, sweet and juicy, and of good quality, free. First of October.

Bavay (*Reine Claude de Bavay*).—Tree vigorous and productive, smooth; fruit large, round-oval, depressed, greenish yellow with red dots and pinkish green stripes; flesh juicy, yellow, sugary, of fine quality, nearly free. October. Desirable both for home use and market.

Of the comparatively new sorts that are meeting with favor where they have fruited are *Moore Arctic*, naturally quite hardy, but the foliage drops badly and hence it often winter-kills. Tree vigorous, smooth, grayish-brown, and an early and abundant bearer. Fruit small to medium, round-oval, purplish-black with blue bloom. Stalk medium, slender, in a narrow cavity. Flesh greenish-yellow, rather coarse, juicy, sweet, pleasant, adheres slightly to stone. Seems to have little to recommend it, although it has been largely planted on account of its supposed hardiness and earliness.

Shipper's Pride (Fig. 6).—Tree vigorous, quite hardy and productive. Fruit above medium in size, oblong-oval, deep purple with thick, blue bloom. Middle of September.

French Damson.—Tree more vigorous and a better grower than the other Damsons, hardy and very productive. Fruit of medium size, deep copper color with a rich bloom. Middle of October. Considered the best of the Damsons by Mr. Willard of New York.

Peters Yellow Gage.—An old but little known plum. Trees fairly vigorous, with short, downy branches. Fruit medium to large, roundish-oval, light yellow, marbled with red in the sun, and with a thin bloom. Stalk large and stout, set in a wide cavity. Flesh yellowish, sweet and juicy. One of the best of the yellow plums. Last of August.

Stanton.—Tree a good grower, fruit medium to large, round-oval; deep purple with a thick bluish bloom. Quite productive. Last of September and early October. An excellent keeper and a promising late sort for canning purposes.

Purple Egg (*Hudson River*).—Tree vigorous and quite productive. Fruit large, purplish-red with thin bloom. Flesh deep yellow, rather coarse. Last of September. A promising market sort.

Of the other new and promising sorts are Czar, Grand Duke, Murdy, Prince of Wales, Black Diamond, and Early Rivers (Rivers Early Prolific).

Simon (*Prunus Simoni*).—Tree small, upright, branches rough. Leaves are small, narrow, and glossy. Blossoms small, very early and hence very likely to be injured by frost. Seems to be a productive sort in this State. Fruit of medium size, round, flattened, with a well marked basin at apex, firm. Color, reddish-purple with brown dots; flesh dull yellow, sweet, rather dry, slightly acrid. Last of August. It seems to have no qualities that make it especially desirable.

AMERICAN PLUMS.

In the common works upon pomology little attention has been paid to any except the varieties of European origin (*Prunus domestica*). There are, however, a large number of varieties in cultivation that are derived from native species. While many of them are largely grown in sections of the South and West where the European varieties do not thrive,

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they are of but little value in most parts of Michigan. Even when productive, they are generally small in size, with a tough skin and firm flesh, and many of them are of an acrid nature.

Until recently our cultivated native plums have been grouped into two species, the American or Canadian wild plum (*Prunus Americana*, Marshall) and the Chickasaw plum (*P. Chickasa*, Mich.) A few years since they were carefully studied by Prof. Bailey of Cornell University, and a new classification made as follows:

Group A. The Americana Group (*Prunus Americana*, Marshall).—This species is found from New England to the Rocky mountains and extends from Manitoba to Texas. In the group are placed a number of hardy, strong-growing varieties "characterized by a firm, meaty, usually compressed, dull-colored, late fruit, with thick and usually very tough, glaucous skin, and large more or less flattened stone which is often nearly or quite free, and by large obovate, thick, veiny, jagged, dull leaves." "The fruits are somewhat flattened at the ends, and are commonly marked by a distinct suture. All of the varieties have a light purple bloom." Among the best varieties of this group are Cheney, De Soto, Forest Garden, Hawkeye, Louisa, Maquoketa, Purple and Yellow Yosemite, Rollingstone and Weaver. Wolf and Van Buren are classed as *Prunus Americana* var. *Mollis*, from the fact that they have pubescent shoots and foliage.

B. Wild Goose Group (*Prunus hortulana*, Bailey).—This embraces all varieties with a "wide-spreading growth and mostly smooth twigs, a firm, juicy, bright colored, thin skinned fruit which is never flattened, a clinging, turgid, comparatively small, rough stone, which is sometimes prolonged at the ends, but is never conspicuously winged-margined, and by comparatively thin and firm, shining, smooth, flat, more or less peach-like, ovate-lanceolate or ovate, long pointed leaves which are mostly closely and obtusely glandular serrate, and the stalks of which are usually glandular." This species is found in the Mississippi valley from Illinois southward.

The species seems to be more closely allied to the Chickasaw than to the Americana group. "The fruits are usually covered with a thin bloom and are more or less marked by small spots. In color they range from a vivid crimson to pure golden yellow." On the other hand the varieties of *P. Americana*, seldom, or never, bear fruits of a pure yellow color, being more or less clouded and splashed with red. They are also generally thin skinned and of a dull color. Prof. Bailey recognizes two types in this group, one of which is characterized "by thin and very smooth peach-like leaves, which are very finely and evenly serrate" (Wild Goose), while the other is distinguished by "thicker, duller and more veiny leaves, which are more coarsely and more or less irregularly serrate." (Moreman, Wayland and Golden Beauty.) The latter type seems to connect the plums of the Miner type quite closely with those of the Wild Goose group.

C. Miner Group (*P. hortulana*, var. *Mineri.*)—It differs from the species "by the dull and comparatively thick leaves, which are conspicuously veiny below and irregularly coarsely toothed and more or less obovate in outline, by a late very firm fruit and by a more or less smooth and Americana-like stone." Most of the varieties are quite hardy and are among the best of the native plums for southern Michigan. The best varieties are Clinton, Forest Rose, Miner and Prairie Flower.

D. Chickasaw Group (*P. angustifolia*, Marshall), (*P. Chicasa*, Mich).—The trees of this group have a slender, spreading and irregular

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growth, the trees are smaller and the leaves are small, lanceolate or oblong lanceolate, closely serrate, shining and generally folded together or trough-like in appearance. The twigs are red and bear, on spurs upon the old wood, dense clusters of small flowers, quite early in the season. The fruit is small, generally red, and more or less spotted; the "flesh is soft, juicy, and more or less stringy and very tightly adherent to the small, broad, roughish stone." The small-leaved type of the Wild Goose group greatly resemble some of the varieties of the Chickasaw. Even in a cultivated state some of the varieties are quite thorny. Several of the Texas varieties are lacking in hardiness. Among the best of the Chickasaws are Newman, Pottawatamie and Robinson.

E. Marianna Group.—In this class were placed the Marianna and De Caradeuc, both of which have originated from the Myrobalan plums, the former as a hybrid with some native sort and the disseminator of the De Caradeuc whose name it bore believed it also to be of hybrid origin.

The DeCaradeuc is a valuable plum in some localities.

The Marianna was highly recommended as an early market plum when it was sent out, but its principal value is as a stock for other plums. It grows readily from cuttings and it has all of the good features of the Myrobalan and none of its bad ones when used for that purpose.

Many of the American varieties are incapable of fertilizing themselves. It has been particularly noticed with such well known sorts as the Wild Goose and Miner and from their failure to bear fruit the whole class has been condemned. When planted in alternate rows with some good pollenizers they will be found almost sure bearers. However, it must be stated that for nearly all sections of Michigan, the much more desirable European sorts can be grown to such perfection that there is but little occasion for the planting of American varieties.

JAPANESE PLUMS.

Within the last ten years quite a number of varieties have been brought into notice that have come from Japanese species. Most of them have been traced to *Prunus Mume*, either directly or as hybrids between that and some other species. One of the first of this class was the *Kelsey*, which is a large fine plum in the south, but it is not sufficiently hardy for successful planting in Michigan, Under the name of Botan an extremely hardy race of plums has been introduced. It includes both red and yellow varieties and the much lauded *Abundance* plum is sometimes, and properly, called Sweet Botan. It is quite hardy, very productive and although the fruits are not large it is a quite desirable early plum.

The *Burbank* and other seedlings originated and sent out by Luther Burbank of California have been planted in portions of the state where the climate is tempered by Lake Michigan, and they seem hardy there, but it is too soon to judge of their value, although they are very promising varieties.

The *Satsuma* is another variety of Japanese origin. It starts into growth very early and it is probable that it will be tender except in protected locations.

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INSECTS AND DISEASES OF THE PEACH AND PLUM.

The intelligent and skillful commercial grower of these fruits is blessed by a large number of insect friends—*blessed* and *friends* because if not for them so many persons would engage in the business, and the crops would be so large that the price at which they would sell would not pay for their cultivation. Under the present conditions, the number of growers is kept within bounds, and fair prices can be obtained, but even now the man who makes use of the remedies at his disposal in a rational manner will have large and perfect fruit, in years when his less intelligent or less industrious neighbor may have lost his entire crop, or will have inferior specimens that will be a drug in the market, even in a year of scarcity and of high prices. The fact that many of our insecticides and fungicides can be used in combination greatly simplifies and reduces the expense of preparation and application.

Every grower who expects to secure a crop of plums takes some means to destroy the curculio, and the day is not far distant when every successful peach and plum grower, to say nothing of the growers of other kinds of fruit, will make as free use of his spray pump for the application of insecticides and fungicides, as he now does of his curculio sheet. Their use is rapidly increasing and last year the amount of copper sulphate sold in the State of Michigan for use in fungicides was not less than five tons.

In addition to the remedies given, too much stress cannot be placed upon the importance of securing vigorous trees, by use of proper soil and a suitable location, an abundance of mineral fertilizers and, above all, thorough cultivation. Clean cultivation not only aids the trees in their growth, but it breaks up the hiding places of insects. Untidy fence-rows are favorite breeding places for insects, and should not be tolerated. In the following pages will be found formulæ for some of the standard insecticides and fungicides, and descriptions and life histories of some of the more injurious *friends*.

FUNGICIDES.

In Bulletins 59, 83 and 92 formulæ have been given for many of the more useful fungicides, but as they may not be at hand we repeat several that will be found valuable.

Bordeaux Mixture.—Slake two pounds of stone lime, and dissolve two pounds of copper sulphate in a wooden or earthen vessel, pour together and dilute so as to make from twenty to forty gallons as desired. Care should be taken to properly slake the lime, as injury to the foliage may otherwise result. A small amount of hot water may be used, or if cold water is employed it should be added only as fast as the lime will take it up. Air-slaked lime may be used, but the amount should be increased one-half. To make sure that all of the free acid of the copper sulphate has been neutralized by the lime, after they have been poured together, and been thoroughly stirred, add a few drops of ferro-cyanide of potassium, and if it gives a brown color it indicates that more lime is needed, and it should be added until no effect can be produced by the ferro-cyanide. When that condition can be secured it shows that the free acid has been taken up, and that there will be no danger from using the mixture properly diluted upon any foliage. Of the various strengths for this mix-

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ture there seems to be little difference in the effect, whether one pound of copper sulphate is used to ten gallons of water or for fifteen gallons, but if much more water is used the efficiency is reduced. For all applications before the leaves appear we prefer to use at the rate of two pounds of copper sulphate to twenty gallons of the mixture, and increase the amount of water by about five gallons for each subsequent application. If the first and second sprayings are made in a thorough manner at the proper times, *i. e.*, before the buds start, and just after the petals have fallen from the blossoms—a third application at from three to four weeks after the second will suffice unless it is desired to control the curculio by means of Paris green, in which case an intermediate spraying with that material alone, about two weeks after the second application of Bordeaux mixture, will be desirable although, as the cost of the material is so small, it will be well to add the copper sulphate, the lime being necessary to prevent the burning of the foliage by the Paris green.

Ammoniacal Carbonate of Copper.—Dissolve three ounces of copper carbonate in 3 pints of ammonia water (26°) and dilute before using with 32 gallons of water. The original solution if kept in a glass stoppered bottle will retain its strength for a long time.

This mixture seems rather less effective than the Bordeaux mixture in the destruction of fungi and is more likely to injure the foliage; in fact it is hardly safe to use it upon the peach, particularly as it is only applied in midsummer, when it is not desirable to use lime upon the ripening fruits. So far as the spotting and poisoning of the fruit with the preparation are concerned there is but little danger, although it is not advised to spray fruits with it that are to be gathered within three weeks.

As sold upon the market copper carbonate costs from 30 to 50 cents per pound, but it can be made for less than half those prices. To make it dissolve one pound of copper sulphate and one pound of carbonate of soda. Pour together and, in the precipitate that forms, there will be the equivalent of eight ounces of copper carbonate. Turn the water off and either allow the precipitate to dry, or use at once as desired. The modified *eau celeste* is practically the same as the ammoniacal carbonate of copper, made as above, except that it contains more copper carbonate and it is rather more effective.

INSECTICIDES.

In order to make an efficient use of insecticides one must not only understand the methods in which they act, but he should have at least some general information regarding the habits of the insects to be treated. Many of the failures reported are due to lack of this knowledge, since a remedy may be used that is unsuited to the purpose, as a little knowledge would have shown. Not only are remedies for sucking insects used upon leaf-eating forms and *vice versa*, but many persons seem to have an idea that spraying will prevent all injuries to their fruit, and without giving thought to the proper remedy expect to destroy insects by the use of fungicides, or the reverse.

Arsenites.—For all leaf-eating insects some form of poison should be used, when it can be placed so that they will obtain it. The more common remedies are Paris green (arsenite of copper) and London purple (arsenite of lime). White arsenic and corrosive sublimate are used by

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some persons, but while less expensive are rather more dangerous to have around.

Paris green is rather more efficient than London purple and being less soluble is not so likely to injure the foliage. When purchased in large quantities the cost is little if any more and if to be used in combination with Bordeaux mixture, as is generally desirable, it is preferable to London purple, as the Paris green itself is quite a valuable fungicide. When used alone, however, the water must be kept continually in agitation to prevent it from settling and as there is less danger of this with London purple it has the preference under those conditions.

Neither of these arsenites can be used alone in a proper strength upon the peach, except very early in the spring, without danger of burning the foliage. They can, however be added to Bordeaux mixture at the rate of one pound of arsenite to 250 gallons of the mixture, and the lime will serve to neutralize any free acid. If it becomes necessary to use them independent of the Bordeaux, they can be rendered innocuous if one pound of lime is added for each pound of the arsenite. Combined in this way, it can be used even upon the peach, as strong as one pound of London purple, or Paris green to 200 gallons of water.

Kerosene Emulsion.—This is the best known specific for such insects as obtain their food by sucking it through a tube-like proboscis, although it is fatal to nearly all insects with whose bodies it is brought in contact. It can be readily prepared by heating one quart of soft soap until it becomes liquid, then remove from near the fire and add one pint of kerosene. With a force pump violently agitate the mixture for from three to five minutes until it becomes homogeneous and cream-like throughout. Stirring should not be relied upon, and even when the pump is employed there will be danger from its use if, on standing, the oil collects upon the surface. Every precaution should be taken to secure a perfect and stable emulsion for which rapid work is necessary, which should be kept up until a foamy mass is secured. Before using add six quarts of water so that the kerosene will be about one-sixteenth part of the mass. If soft soap is not at hand from two to four ounces of hard soap may be used instead. Dissolve it in a quart of hot, soft water and after bringing it the boiling point, remove from the fire, add the kerosene and proceed as before. Even more care will be necessary in securing a stable emulsion than when soft soap without water was used.

It should be remembered that, to be effectual, this remedy must be bought in contact with the body of the insects, and as the leaves oftentimes act as a shield, it will need to be applied with considerable force through a fine nozzle in order to produce a mist-like spray.

Carbolic Acid.—The use of this substance about plum and peach trees seems to prevent the curculio and other insects from depositing eggs. The usual way of applying it is as carbolate of lime, or as "carbolized plaster." A half pint of crude carbolic acid is mixed with about fifty pounds, either of air-slaked lime, or with land plaster (gypsum), and thrown over the trees while the dew is on, about the time the blossom have fallen. It should be repeated twice at intervals of ten days, or oftener if washed off by rains.

Carbolic acid can also be used to advantage, combined with kerosene emulsion, for washing the trunks of peach, plum, and other fruit trees, for the destruction of insects; one pint will answer for ten gallons.

Other Remedies.—For the destruction of aphides, scale, and simi-

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lar insects, there are several effective remedies, although none of them equal kerosene emulsion. Strong soap-suds will be found a simple and quite effective remedy, and tobacco tea is even more reliable. This can be made by soaking tobacco stems in hot water. For some purposes pyrethrum, or buhack, will be of value. This can be applied as a powder with a bellows, or in water at the rate of a teaspoonful to the gallon.

LEAF-EATING INSECTS.

Under this heading we may include any forms that injure the foliage by biting and chewing the foliage. The plum has something like forty insects that have been known to feed upon it, and there are at least ten that have been found injuring the foliage of the peach. None of them, however, are particularly troublesome, as it is only in rare instances that they become sufficiently numerous to be injurious. When their presence is discovered, it will be a very simple thing to destroy them by the use of Paris green, and as a safeguard we would always recommend the addition of a small quantity, say two oz. to forty gallons, whenever Bordeaux mixture is applied during the growing season, and at the present time the extent of the injury caused by fungous diseases is such that the application of this fungicide should not be neglected.

The cherry slug (*Eriocampa cerasi*) sometimes appears upon the plum, but can be controlled by the arsenites.

SNOWY TREE CRICKET.—(*Oecanthus niveus*, Serv.)

The branches of the plum and peach are often punctured by this insect and eggs are deposited in the punctures. They select the young growth of the trees and make their punctures in long lines one above the other, until from thirty to fifty eggs have been deposited; sometimes a half dozen or more groups of punctures are made upon a single branch. The injured tissues become dry and the branch is much weakened, although if in a vigorous, growing condition the injury soon becomes covered up. Some of the punctured branches can be cut away but in recently set trees it is generally impossible to cut all of them out without removing too many of the shoots.

The eggs hatch in the early Summer and the mature insects are rather beneficial than otherwise, as they feed upon plant lice. In the Fall they deposit eggs and if they are so numerous as to need a remedy, this is the best time. As soon as they are found to be at work, the trees should be sprayed with kerosene emulsion to which one pint of crude carbolic acid has been added for fifteen gallons of the emulsion. It must be confessed that this is not an ideal remedy, as, while the kerosene will kill all the insects it touches, its effects are not lasting, the carbolic acid merely tending to keep the insects from depositing eggs in the trees sprayed, and driving them to other plants. The raspberry, currant and grape are also injured by the snowy cricket.

PLUM CURCULIO.—(*Conotrachelus nenuphar*, Herbst.)

The fruit of the plum, peach and cherry, as well as the apple and pear, are often much injured by the larvæ of this pest, so much so that unless precautions are taken it is almost impossible to secure a crop. The plum

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and peach are so injured that they drop from the trees, while the presence of the worms in ripe cherries not only ruins those containing them, but renders the others objects of suspicion.

The perfect insect is a grayish-black beetle about one-sixth of an inch long, with a hump upon each wing cover and a short curved snout, which is turned back beneath the thorax when not in use.

The insects appear about the time the trees blossom (sometimes a few days before), and, as soon as the fruits form, deposit one or more eggs in each. With the snout a small hole is made, upon the side of the fruit, and a cavity is excavated just under the edge of the skin, in which an egg is deposited. To cause the growth of this part of the fruit to stop and thus to prevent the egg from being crushed, the beetle makes a crescent-shaped cut (thus ☾) around the egg. In this mark we have an infallible sign of the work of this insect. Ovipositing continues for about ten days, from five to ten being deposited daily.

The eggs generally hatch in from four to seven days, the larvæ being small, white grubs. They feed upon the flesh and quickly eat in to the stone, around which they feed. They reach full size in from three to five weeks, and the fruits are often so injured that they fall to the ground before this time. When full grown the larvæ emerge from the fruit and enter the ground to the depth of five inches where they change to pupæ and at the end of from four to six weeks become fully developed beetles. In this form they pass the winter hidden under the rough bark, or other similar protection, and come out in the spring ready for work. The mature beetles contrary to former belief, feed upon the foliage and bark, and even eat holes in the young fruits merely for the purpose of obtaining food. From the life history as given above, various preventive remedies are self evident. It will always be well to have all fruit as it falls eaten by hogs or sheep, while poultry are quite useful in a plum orchard. In thinning the fruit those removed can readily be dropped into baskets and then burned. Frequent cultivation at the time the insects are entering the ground will destroy many of them, and fall plowing will also be beneficial. If the trunks of the trees are washed in the early spring with kerosene emulsion we shall both kill many curculio, as well as other insects, and deprive them of a hiding place under the bark as the growth will be less likely to crack. As a rule, however, this will not suffice and other remedies must be resorted to. The most effectual is the shaking or jarring of the trees at the time the insects are depositing their eggs. While the curculio may fly from tree to tree during the day, in the early morning they are not active and if disturbed they generally fall upon their backs and play possum. By jarring the trees at this time they are thrown down and can be caught upon sheets. A screen is made from eight to twelve feet square by tacking cotton cloth upon a light frame-work, with an opening in one side large enough to admit the body of the trees, or two narrow frames may be used, one upon each side of the trees. Another form of screen is often made by tacking strips of wood to two opposite sides of a square of cloth

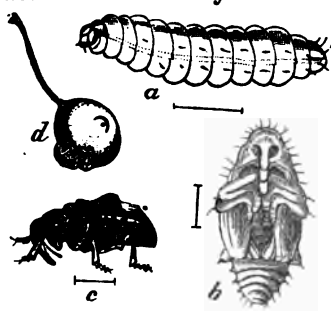

FIG. 7.—PLUM CURCULIO,
a larva. *b* pupa. *c* adult. *d* plum stung.

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of suitable size, which is open to the center from one end to admit the tree. Sometimes a screen is mounted upon a wheel-barrow. The trees are jarred by bumping them with a maul padded with rubber to prevent injury to the bark. To admit of giving heavy blows to large trees, some of the branches are cut off leaving stubs to pound against, or pieces of half-inch gas pipe or large nails may be set in the trees for this purpose. The frequency and number of jarrings will depend upon the abundance of the curculio, varying from daily to three or four days apart and continuing for from one to three weeks. The insects should be collected upon the screen and placed in a pan with a little kerosene in the bottom.

While the jarring is the surest way of fighting this insect, the use of arsenites will generally be effectual in saving enough for a crop if they have been kept in check in previous years.

With a good setting of fruit and a comparatively small number of insects, a good crop will be insured by spraying, and where the treatment is kept up from year to year little or no harm is done by the curculio, even when no jarring has been done. While spraying is sure enough to be recommended as above, especially if Bordeaux mixture is also used, we advise all to watch their trees, and if the curculio are present in numbers to jar and thus make sure of them.

The first spraying should be made as soon as the blossoms fall, and will need to be repeated about twice, at intervals of ten days. If rains intervene three or four applications at shorter intervals should be made.

By combining arsenites with Bordeaux mixture we shall also have a remedy for the various fungous diseases of these fruits, and will both render impossible the burning of the foliage and make it more efficacious as an insecticide, as the lime will tend to hold it for a longer time upon the foliage, and will also in part prevent the deposition of the eggs.

The use of carbolized lime also will be found of value, when the arsenites are not employed, or a similar result, *i. e.*, the driving of the insects away from the trees can be secured by the addition of about one pint of crude carbolic acid to twenty gallons of Bordeaux mixture.

THE PLUM GOUGER. (*Coccotorus prunicida.*)

The gouger in some respects resembles the curculio, but it differs in being of a grayish-brown color with frequent white and black spots upon its back; its legs and thorax are of a dull yellow color. In size it is something over one-fourth of an inch long, and its snout is stout, projecting to the front, so that it cannot be doubled back under the body. The eggs are placed in pits that the insect bores in the fruit of the plum nearly as deep as its snout is long. The pits are enlarged at the bottom and the snout is used in pushing the eggs to the lower end. The larva upon hatching eats its way into the seed and feeds upon its kernel. It pupates within the stone, and then emerges as a perfect beetle in September. The gouger is seldom very injurious but the same remedies answer for it as for the curculio, whenever it does appear.

THE ROSE CHAFER—(*Macrodactylus subspinosus*).

The rose chafer, rose beetle or rose bug, as it is variously called, is frequently quite injurious from its eating the flowers, young fruits, and leaves of the peach and plum, as well as the grape, apple and other fruits, and various flowers.

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It proves ironclad against the arsenites and kerosene emulsion, and the only effectual remedy is hand picking in the cool of the day. The use of carbolic acid as recommended for the plum curculio seems to be distasteful to the beetles and tends to drive them away. Clean cultivation undoubtedly tends to destroy them to some extent, as they pupate in the soil.

THE APHIDES OF PEACHES AND PLUMS.

Both fruits are often injured by plant-lice. The foliage of the plum is attacked by the so-called plum-tree aphis (*Aphis prunifolia*, Fitch), while the peach tree aphis (*Myzus percicae*, Sulzer), attacks the leaves and twigs of the peach, and the black peach aphis (*Aphis persicae-niger*, Smith), attacks roots, leaves and tender shoots.

The plum tree aphis, when first hatched, is of a greenish-white color, but it soon grows darker, and later in the season becomes nearly black. Like other plant lice, these insects obtain their food by sucking the juice from the leaves and young shoots. This tends to weaken the plants and the leaves become more or less blistered, and finally roll up. If the attack is severe they may drop from the trees.

The eggs are deposited upon the branches, at the base of the buds or in cracks in the bark, in the Fall. The insects are hatched about the time the buds open in the Spring. The first brood consists entirely of females, which develop in ten or twelve days, after which, for some three weeks, they give birth to about two young aphides daily, and then they die. This is repeated by the successive broods until cold weather approaches, when both males and females are produced. After pairing, the females deposit eggs as noted above.

These insects obtain their food by sucking the juice of plants through their long, slender beaks. It will be seen that they cannot be destroyed by the use of arsenites, and some remedy must be employed that will kill by contact.

For the aphides upon our fruit trees we have no better remedy than kerosene emulsion, although tobacco water, soap suds, and pyrethrum in water are valuable.

The peach-tree aphis works in about the same way as does the plum aphis and the same remedies should be employed. Like the plum aphis, some of the females and also the males are winged, to permit them to seek fresh pastures after one has been fully occupied. The winged females are nearly black in color and about an eighth of an inch in length, while the wingless individuals are of a yellowish red color. The males are yellow with brown markings.

The black peach aphis has been very destructive in the eastern States, where it is found in large numbers upon the branches in the Spring, often killing outright small trees and the younger branches of the older ones; they have destroyed entire orchards in some localities and are particularly troublesome to the young tress in nursery rows. They are dark brown or black in color, and have unusually large beaks.

As noted above, this aphis also feeds upon the roots of the trees and upon sandy soil it is particularly destructive. Dr. E. F. Smith who first discovered its workings attributes to it many so-called cases of yellows. The trees made a weak growth, the leaves were yellow and shrivelled, but none of the distinctive features of yellows were present. The fact that this insect has an underground existence favors its development, as it is out of

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the reach of ordinary remedies. They are most likely to appear upon trees growing in exhausted soil, hence we should ward off their attack by supplying proper food. If they appear, the use of several pounds of common salt, kainit or muriate of potash to the tree will destroy the subterranean form. All of the above species are destroyed by the common "lady-birds." These, as mature insects, are about three-eighths of an inch in length and nearly as wide. They are beetles and somewhat resemble a small Colorado potato beetle except in color, which in this insect is generally yellow or red, or some intermediate shade, with from one to fifteen, generally round, spots upon the wing covers. The larvæ of this insect and of the lace wing and syrphus flies are also quite destructive. They should be recognized as friends, and not treated as enemies.

THE PLUM-TREE BORER. (*Aegeria pictipes.*)

The trunk and branches of plum trees are often considerably injured by the larvæ of this insect, which gnaw the inner bark and new wood of the trees. The flat-headed apple-tree borer and the peach-tree borer are also sometimes found in the plum tree. An idea of the life history of these insects and the remedies for them can be obtained from the following lines regarding the peach-tree borer.

THE PEACH-TREE BORER.—(*Sannina exitiosa.*)

This is one of the most destructive insects that the peach grower has to contend with, as, unless its attacks are guarded against, the very life of the trees is menaced. The borers are hatched from eggs that are deposited upon the trunk by moths that have a general resemblance to wasps, and at first sight are often mistaken for them. The male has transparent wings with a spread of about seven-eighths of an inch. It has a slender bluish-colored body with yellowish markings. The female has a wing spread of fully one and one-fourth inches, the front pair being opaque and of a glossy, blue color, the same as the body, while the hind pair are transparent with dark margins. The body of the female is cylindrical and considerably larger than that of the male. As a rule, the eggs are deposited close to the ground, but are sometimes placed higher up on the trunk. They soon hatch and the larvæ eat their way through the bark and generally work their way towards the roots. The sap together with the castings extrudes and forms a gummy mass at the surface of the ground. The full grown larvæ measure about three-fourths of an inch in length, and are of a yellowish-white color with black jaws and a yellow head. The larvæ remain at rest during the winter, but in the spring after completing their growth they form cocoons at, or just beneath, the surface of the soil and close to the root of the tree. After three or four weeks, the perfect moths appear, generally during July or August, and soon deposit eggs of other broods. The presence of the borers can readily be detected by the gummy exudation and steps should at once be taken to remove them. The tree should be examined in the autumn and again in the Spring, and all borers dug out with a sharp-pointed knife. In order to find them readily, the soil should be drawn away from around the trees, but it must be replaced lest the trees be injured during the winter. Under all conditions, the destruction of the larvae should not be neglected and as a rule it will be sufficient, but, in localities where they are very troublesome it is well to apply some kind of a wash to the trunks of the trees about the first of July, to prevent the

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deposition of the eggs. One of the best washes is made by thinning down soft soap until it is of the consistency of thick paint and adding a tablespoonful of crude carbolic acid to each gallon of wash. Paris green and lime are also added by some people. The wrapping of thick paper, or of fine, wire netting, about the tree trunks will also keep the insects from depositing their eggs.

MICE AND RABBITS.

In orchards where the trees are growing in sod, or where there is litter of any kind about the trees, mice sometimes girdle them, and rabbits are frequently quite troublesome. In the first case, a remedy will be found by removing the conditions that favor the mice, which are also of themselves injurious to the trees. If this cannot be done, a mound of soil free from litter placed around the trees to a height of one foot will save them from the mice. Mice, and to some extent rabbits, can be fenced out by wrapping the trees in the fall with paper or netting. Another remedy is to paint the tree trunks in the fall with a lime, or cement wash, to every ten quarts of which a heaping tablespoonful of Paris green has been added. The smearing of the tree trunks with blood is claimed by some to keep away rabbits.

PEACH YELLOWS.

Of all plant diseases none is to be more dreaded than the one that for the want of a better name is known as the "yellows" of the peach. The character of the soil, its location and the variety of the peach seem to have no effect upon its appearance, and whenever it manifests itself the best thing to do is to immediately dig out and burn the trees. Nothing is positively known of the nature of the disease, but as it is undoubtedly contagious it is probably caused by some low form of vegetable parasite allied to the bacteria. The disease has been studied by many persons both chemically and microscopically and for six years the Department of Agriculture has had an expert who has given his entire attention to studying and experimenting with diseased trees; every means has been afforded him, but, although much valuable knowledge has been acquired regarding the disease, nothing has been learned of its real nature. The disease has been at various times ascribed to the effect of soil exhaustion, of borers, of cold, of root aphides, of eel worms (*Anguillulæ*), of wet subsoil, neglect of cultivation or of pruning, the excessive use of nitrogenous manures, or the use of pits or buds from diseased trees. If trees are propagated from either pits or buds of diseased trees the yellows will undoubtedly appear, but experiments by Dr. Erwin F. Smith, the expert mentioned above, and others, seem to show conclusively that the other conditions will not of themselves cause yellows to appear in the peach although they may induce an appearance that to the inexperienced eye may resemble that disease. It is also very probable that trees weakened by any of the above adverse conditions may be particularly susceptible to it.

HISTORY OF YELLOWS.

Although we have no definite information regarding the time and place of the appearance of yellows, it is quite certain that the disease has been known for at least one hundred years in the neighborhood of Philadelphia, and from that point it gradually spread in all directions appearing in New York in 1801 and in Massachusetts in 1818. Within recent years it

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has exterminated the peach orchards of Maryland and Northern Delaware and is gradually spreading southward. It appeared in Berrien Co., Michigan in 1866, the germs being presumably brought in nursery stock from New Jersey. For a few years it spread very slowly but after 1875 it became very destructive and showed itself in nearly every orchard in the county. In 1874 there were fully 650,000 peach trees in Berrien county and in 1877 the shipments were more than a half million baskets, but such was the virulence of the disease that after 1875 few orchards were planted, as young trees were carried off within two or three years. The attack was so severe and so widespread that the number of the trees in the county fell to 50,000 in 1884 and in the townships of Benton and St. Joseph, where it first appeared hardly a tree remained. It worked northward and appeared at South Haven in 1869 and at Paw Paw about 1877. The disease was not particularly destructive at South Haven until 1875, but from that year until 1880 it increased in virulence. The fruit growers of South Haven, profiting by the experience of their neighbors at the south, waged a war of extermination and, where it was followed up, the loss was quite small. In some cases the proper precautions were not taken and entire orchards were destroyed. The history of the disease is about the same in Allegan, Kent and Ottawa counties, where it appeared later. While it has undoubtedly appeared in other counties it has done little harm. It behooves the peach growers in all parts of the state to be on the watch and on its first appearance to stamp it out. With our present lack of knowledge of the real cause of yellows, we can do no more than to subject the trees to such conditions as will be most likely to keep them healthy. We should then, use trees free from taint of disease, plant upon high, well-drained soil, avoid the use of excessive quantities of nitrogenous manures, supplying necessary plant food for the most part in the form of chemical fertilizers; give frequent, regular cultivation; cut back and thin out the trees to secure a strong growth; remove all surplus fruit while still small and thus prevent it from drawing needlessly upon the trees; fight early and late against the borers and other insects, the curl leaf, rot and other fungous diseases. This treatment should give us strong, vigorous trees that will be more likely to escape the attack of the yellows than those grown under opposite conditions would be. While it is believed that favorable conditions for the growth of the trees will render them less susceptible to this and all other diseases, it is not claimed that the trees will have entire immunity and it is not likely that a case of yellows can be cured if it once appears in a tree, but if yellows make their appearance in an orchard where some of the conditions are unfavorable, it is probable that, if the diseased trees are at once removed and the remaining trees are given proper care, they will be less liable to attack than if nothing had been done except to remove the diseased trees. From the fact that we have no definite information, as has been previously stated, regarding the exact nature of the disease, the above cannot positively be stated to be correct, but from our general knowledge of plant physiology, and the fact that plants as well as animals that are in a healthy condition and with congenial surroundings are less subject to disease, than those that are weak and exposed to unfavorable conditions, it will be well for the practical fruit grower at least to hold to this belief until it has positively been demonstrated to be false. The course recommended is the one that will be most likely to give profitable returns and if in any way it aids in warding off the disease it will be so much gained, while if it fails to do this there will be no loss.

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TREATMENT FOR YELLOWS.

If the disease makes its appearance, there is but one thing to be done, and everyone now advises that the tree be at once dug out and burned. It will probably be best to dig around the tree and take out the trunk and the larger roots to a distance of perhaps two feet from the stem, although some growers top off the branches and later on cut out the stump. The removal should take place immediately after a tree is found to be diseased, and all growers should familiarize themselves with the appearance of the disease in its first stage, that it may be taken in hand in time.

APPEARANCE OF YELLOWS.

While by some persons the term "yellows" is applied to almost any unhealthy condition of the trees that gives them a yellowish appearance, the true "yellows" as known to peach growers is a specific disease with certain well-defined symptoms by which it can be recognized.

While it may be somewhat modified by local conditions, it almost invariably passes through certain changes and runs a definite fixed course. The yellows first manifest themselves in a tree, in the premature ripening of the fruit. In a healthy tree each variety has a somewhat definite time of maturity, but, if the tree is attacked by this disease, the fruit may color up two or three weeks before those on the neighboring trees of the same variety are ripe. The time of ripening, however, is variable, as sometimes the difference is only a few days but in other cases it may be four or five weeks. Not only do they ripen prematurely, but the fruit upon diseased trees is quite different in appearance from that on healthy ones. Besides being much higher colored than healthy peaches, the surface is more or less blotched with dark red dots, giving the fruit a speckled appearance (Fig. 8, 1). As a rule, the blotches are small and show quite distinctly against a lighter background, but sometimes they are so numerous as to run together and give the face, or perhaps the entire surface of the peach, a purplish appearance. A still more distinctive feature is that the discoloration is not confined to the epidermis, but extends into the center of the fruit so that upon being cut open the flesh has a mottled appearance, the coloring being in the form of streaks, dots and splashes; around the pit the coloring is unusually dark, and sometimes in light colored varieties the entire flesh is of a uniform red color. As a rule, the flesh of premature peaches has but little flavor, although in some cases it is slightly bitter. The fitness for food of premature peaches depends upon the extent to which they are affected, as if the attack is but slight they are palatable, but in the advanced condition they are not fit for food. The safest plan is to destroy all affected fruit. The disease may not appear upon all parts of the trees the first season, but if a single peach ripens prematurely and has a spotted flesh, it is an infallible indication that the tree has the yellows in its incipient stage, and there should be no delay in destroying it and its fruit.

We give here a description of the illustrations on the next page; in Fig. 8, 1 represents a peach attacked by yellows. 2. A healthy peach for comparison. 3. Specimen taken in the Autumn, showing how the tree has put out leaves and blossoms from the Winter buds. The Spring foliage has already fallen. 6. Represents a similar specimen. 4. Shows the tufted Spring growth due to yellows. 5. A branch taken in the Autumn; the Spring foliage has nearly all fallen, and autumn leaves have developed from Winter buds. 7. A healthy peach branch for comparison.

(The illustration was kindly loaned by the publisher of the American Cultivator, Boston, Mass.)

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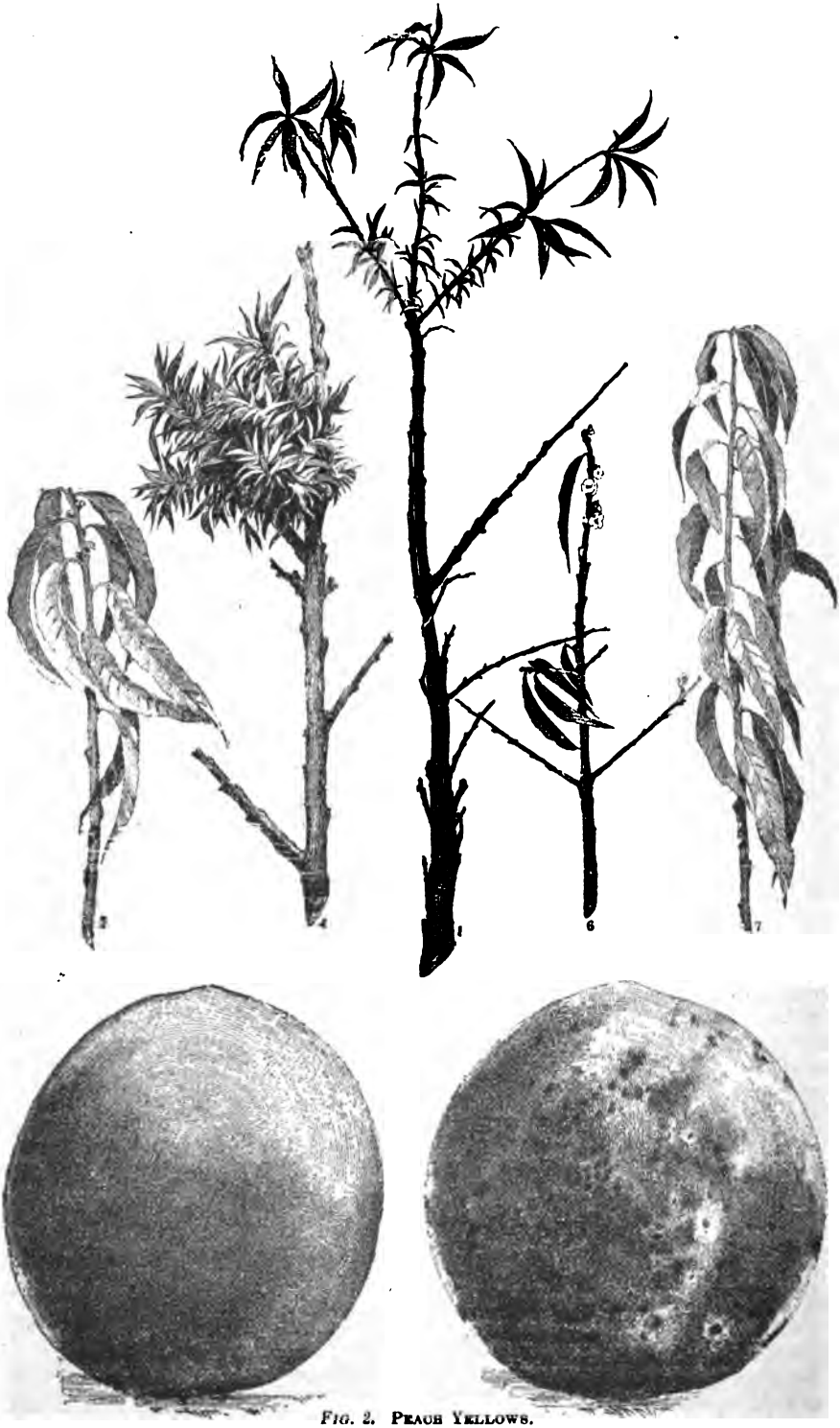

Fig. 2. **Peach Yellows.**

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SECOND STAGE OF YELLOWS.

Following the appearance of the disease in the fruit, it shows itself by the development of small wiry twigs (Fig. 8, 4), commonly spoken of as a fungous growth. While these frequently do not appear until after the tree has given a crop of premature fruit, a tree showing the twigs will always bear diseased fruit. As a rule, if only a small portion of the fruits are premature, the wiry starved growth will not show until the following season, although they may appear in the autumn on the trees that were healthy the previous year. These shoots grow in clusters (Fig. 8, 4) upon any part of the tree, but generally are most numerous upon the main branches and near the forks. Sometimes they are straight and unbranched, but, as a rule, especially late in the season, they are branched, the buds in the axils of the leaves making a premature growth the same season they are formed. The shoots are often short-jointed and form thick tufts. The leaves are small, being about half as long and wide as healthy ones and have a yellowish tinge. The buds are small and generally winter-kill, as the shoots do not mature their growth.

Another way that it appears, is when apparently healthy trees send out in the autumn the small shoots distinctive of yellows, with the pale yellowish-green foliage. The trees show the same symptoms the second year, as were noticed the first, and in addition the fruit, if any is borne, is small, both in size and quantity, bitter in taste, or at least of inferior flavor. All of the tree is now generally involved, and the foliage is quite yellowish and even red in color and considerably curled, particularly on the shoots sent out in the spring. Sometimes the tree dies the second year, but it is usually the third, or perhaps the fourth year that it finally succumbs. The diseased shoots are quite brittle and seem to have little life. There are no well authenticated cases of recovery from this disease. After a tree affected with the yellows has been removed, it is a common practice to set a young tree in its place, and no harm has been noticed from replanting the spring following the removal of the diseased tree. In case the affected tree was left long enough to transmit its contagion to the neighboring trees there would undoubtedly be danger of the newly planted tree becoming in time infected by its diseased neighbors, but at any rate the young tree would be less likely to be attacked than other trees in the orchard. In practice, with prompt removal of diseased trees, there seems to be no danger in replanting the next year, and peach orchards of recent years have suffered but little from the yellows, when steps were taken to promptly eradicate the disease as soon as it appeared. This indicates that up to the time of its outward manifestation, the disease is not readily transmitted.

YELLOWS FROM DISEASED PITS AND BUDS.

While there can be no question that the disease can be communicated to the nursery stock by the use of pits or the buds from diseased trees, we believe there is less danger of introducing yellows into a locality in this way than by means of nursery trees grown in the vicinity of diseased orchards, or where the trees themselves were from healthy stocks but were infected by neighboring nursery trees which may have acquired the disease either through the pit or bud. In the experiments of Dr. Smith less than one pit in a thousand from premature peaches grew, but there may

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be some danger of the disease manifesting itself in trees grown from pits produced by portions of trees that as yet show no signs of yellows, but that will exhibit signs of yellows the following year. In most cases, however, the nursery trees from such pits will show signs of the yellows the first year and will hardly fail to escape the second, so that on purchasing them the fruit grower will be able to detect the disease before the trees are planted.

It is nearly seventy years since it was claimed that yellows could be spread by the buds, and it is quite certain that if buds are taken from a tree in the second stage of the disease few of them will start at all, and those that do, will make but a feeble, unhealthy growth. When from trees that are just coming down with the disease, *i. e.*, when if in bearing a few of the fruits will be premature,—the disease may not appear to any extent in the nursery and an unscrupulous nurseryman will sell the trees that do not show it, in this way scattering the disease. The only safe way is to purchase trees in localities where the yellows either has not appeared or is in check and where one has good evidence that the pits have come from uninfected regions, and the buds are from healthy trees. If any of these precautions are neglected there is great danger of obtaining the germs of the disease. Many growers claim that if, in carrying a diseased tree from the orchard, a branch rubs against a healthy tree, it will convey the disease, and while this may not be true, it is very probable, and prudence would seem to dictate that the tree be cut up and burned upon the spot, or if carried to a brush pile outside, it should be removed with great care not to bring any part of the tree in contact with a healthy one. As soon as possible the trees should be burned. In localities where the disease prevails, if the affected trees are promptly destroyed the loss seldom exceeds three per cent, while if this is neglected it spreads with increasing virulence until every tree may be destroyed. From the contagious nature of the disease, it can be seen that it cannot be guarded against unless there is concerted action in the infected districts and to secure this the State of Michigan has enacted what is known as the "Yellows Law," which reads as follows:

THE YELLOWS AND BLACK KNOT LAW.

AN ACT to prevent the spread of the contagious diseases known as yellows and black knot among peach, plum, cherry, prune, almond, apricot and nectarine trees, or the fruit thereof, by providing measures for the eradication of the same, and to repeal act number one hundred and fifty-eight of the public acts of eighteen hundred and ninety-one, entitled "An act to prevent the spread of the yellows, a contagious disease, among peach, almond, apricot and nectarine trees, and to provide measures for the eradication of the same, and to repeal act thirty-two of the session laws of eighteen hundred and seventy-nine," approved April four, eighteen hundred seventy-nine.]

SECTION 1. *The People of the State of Michigan enact*, That it shall be unlawful for any person to keep any peach, almond, apricot, plum, prune, cherry or nectarine tree, infected with the contagious disease known as the yellows or black knot, or to offer for sale or shipment, or to sell, or to ship any of the fruit thereof, except the fruit of the plum and cherry tree; that both tree and fruit so infected shall be subject to destruction as public nuisances as hereinafter provided. No damages shall be awarded in any court in the State for entering upon the premises and destroying such diseased trees, or parts of trees or fruit, if done in accordance with the provisions of this act.

It shall be the duty of every person as soon as he becomes aware of the existence of such disease in any tree, parts of trees or fruit owned by him to forthwith destroy, or cause said trees or fruit to be destroyed.

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SEC. 2. In any township, city or village in this State in which such contagious diseases exist, or in which there is good reason to believe they exist, or danger may be justly apprehended of their introduction, it shall be the duty of the township or village board, or city council, as soon as such information becomes known to either such board or council, or any member thereof, to appoint forthwith three competent freeholders of said township, village or city as commissioners, who shall hold office during the pleasure of said board, village or city council, and such order of appointment and of revocation shall be entered at large upon the township, village or city records: *Provided*, That the commissioners now appointed and in office shall continue in said office until their successors are appointed and qualified.

SEC. 3. It shall be the duty of said commissioners, within ten days after appointment as aforesaid, to file their acceptances of the same with the clerk of said township, village or city, and said clerk shall be *ex officio* clerk of said board of commissioners, and he shall keep a correct record of the proceedings of said board in a book to be provided for the purpose, and shall file and preserve all papers pertaining to the duties and actions of said commissioners, or either of them, which shall be a part of the records of said township, village or city.

SEC. 4. It shall be the duty of the commissioners, or any one of them upon or without complaint, whenever it comes to their notice that either of the diseases known as yellows or black knot, or other contagious diseases exist, or are supposed to exist within the limits of their township, village or city, to proceed without delay to examine the tree or fruit supposed to be infected, and if the disease is found to exist, a distinguishing mark shall be placed upon the diseased trees and the owner notified personally, or by a written notice left at his usual place of residence, or if the owner be a non-resident, by leaving the notice with the person in charge of the trees or fruit, or the person in whose possession said trees or fruit may be. The notice shall contain a simple statement of the facts as found to exist, with an order to effectually uproot and destroy, by fire, or as the commissioner shall order, the tree so marked and designated, or such parts thereof, within ten days, Sundays excepted, from the date of the service of the notice; and in [cases] case of trees known as nursery stock, or fruit so infected, such notice shall require the person in whose possession or control it is found to immediately destroy the same, or cause it to be done; said notice and order to be signed by the full board of commissioners.

SEC. 5. Whenever any person shall refuse or neglect to comply with the order to remove and destroy the tree or parts of trees so designated and marked by the commissioner as aforesaid, it shall become the duty of the commissioner to cause said trees, or parts of trees to be removed and destroyed forthwith, employing all necessary aid for that purpose. The expenses for such removal and destruction of trees or parts of trees, to be a charge against the township, village or city; and for the purpose of such removal and destruction, the said commissioners, their agents and workmen, shall have the right and power to enter upon any and all premises within their township, village or city.

SEC. 6. If any owner neglects to uproot and destroy or cause to be removed and destroyed as aforesaid, such diseased tree, or parts of trees or fruit, after such examination and notification, and within the time hereinbefore specified, such person shall be deemed guilty of a misdemeanor, and punished by a fine not exceeding one hundred dollars, or by imprisonment in the county jail not exceeding three months, or both in the discretion of the court; and any justice of the peace of the township or city where such trees may be, or where such nursery stock or fruit is sold, shipped, disposed of, or delivered as aforesaid, shall have jurisdiction thereof. The words "parts of trees," wherever used in this act shall refer to the black knot only, and not to trees affected with the yellows.

SEC. 7. The commissioners shall be allowed for services under this act two dollars for each full day, and one dollar for each half day, and their other charges and disbursements hereunder, to be audited as well as any other charges and disbursements under this act, by the township board, village or city council, all of which costs, charges, expenses and disbursements may be recovered by the township, village or city from the owner of said diseased fruit or nursery stock or from the owner of the premises on which said diseased trees stood, in action of assumpsit.

SEC. 8. All of act number one hundred and fifty-eight of the public acts of eighteen hundred and ninety-one, be and the same is hereby repealed.

This act is ordered to take immediate effect.

Approved May 25, 1893.

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It will be seen that the fruit growers of any section have it in their power to secure the prompt destruction of all fruit and trees in which the disease appears. In Berrien, Van Buren and Allegan counties there are numberless cases where the disease has been kept in check, even after it has appeared in an orchard, and one can also find in those same counties other instances in which the law has not been enforced, where the yellows appeared in fully 30 per cent of the trees in 1893, and even then nothing was done beyond cutting off the branches and leaving them on the ground to scatter their contagion, while the trunks of the trees left standing sprouted and sent up wiry shoots that show unmistakably signs of the yellows. If the owners alone are to be the sufferers, after all that has been said and written on the subject, one would hardly waste a thought upon it, but one cannot help feeling sorry for the neighbors whose orchards seem doomed to destruction even though they have not shown public spirit enough (to say nothing of their private interests) to secure the enforcement of the law. As will be noticed, the law also provided for the destruction of the "black knots," upon plum trees, which is a disease fully as fatal as peach yellows, where its appearance is not guarded against. With a little concerted effort, however, this disease also can be readily controlled.

BLACK KNOT. (*Plowrightia morbosa.* Sacc.)

In some parts of the State entire plum orchards have been destroyed by this disease, and there is great danger of its obtaining a strong foothold in the plum-growing districts and crippling that thriving industry. The only hope of safety is in the thorough awakening of every plum grower to the danger that menaces him. If they could see the thousands of acres of plum orchards that have been blotted out by this disease in the State of New York, during the last five years, they might be upon their guard.

In order to successfully combat this disease, all the plum growers in a given locality must be leagued in an intelligent warfare against it. If one man allows the knots to form upon his trees he will spread the disease to his neighbor's orchards. As much of the danger comes from the dispersion of the spores, formed by the knots before they have taken on the black, pimply appearance (Fig. 9, 1) that is usually regarded as distinctive, every one should be familiar with the changes through which the knots pass. The spores (seeds) are borne through the air and, falling upon the branch of a plum tree, soon germinate and penetrate the tissues. They grow there until the following Spring without manifesting their presence. A swelling will then be seen at the point infected, generally two or three inches long; the bark cracks and the branch seems to puff out to twice its normal size. If these incipient knots are cut off and burned at this time, the injury to the tree will be stopped and, what is of most importance, it will be destroyed before it has had time to ripen and scatter its spores. In one or two months if left upon the tree, the knot becomes covered with an olive-green mold, made up of an immense number of spores upon their supporting stalks; these are soon scattered by the wind and disseminate the disease. In the Autumn, a hard black crust forms over the knot; this is covered with minute pimples in which a second form of spores is produced. They ripen late in the Winter and are the source of other knots. Hundreds of knots often appear upon a single tree, and as they not only rob the tree of food, but practically strangle and starve the branches upon which they are located by girdling them and thus shutting off the supply of food, the tree is soon destroyed.

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One source of contagion is through nursery stock, and young orchards should be carefully watched, when trees are obtained from infected districts. Not only is there danger from knots upon other plum trees, but it seems probable that the knots upon the cultivated cherries, choke and other wild cherries, and wild American and other wild plums may be of the same species and be able to communicate the disease to plum trees in our orchards. Experiments by inocculation would seem to indicate that the knots upon choke cherries will communicate the disease to cultivated plums, and the only thing that points to the contrary is that the plum orchards in Oceana county are sometimes surrounded by thickets of the wild pin cherry (*Prunus Pennsylvanica* L.), and yet remain free from disease. However, as these thickets of wild plums and cherries are at best a nuisance, prudence would indicate the desirability of applying the ax and fire to them, as there may be conditions under which the disease may be transmitted. It has been noticed that there are unknown conditions under which the disease has greatly increased virulence. For several years it may make but little headway, but at length a time will come when *it will sweep like fire through the plum orchards and entirely blot them out.*

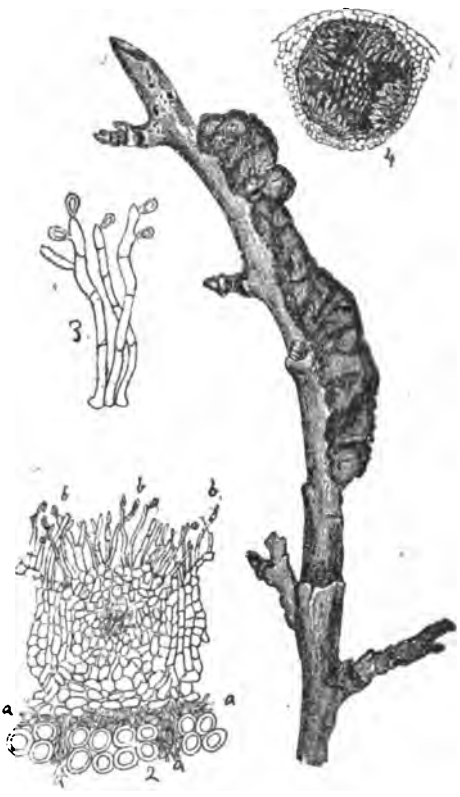

FIG. 9. BLACK KNOT. *Plowrightia morbosa*. Sacc. 1. Stem of plum tree with knot upon it, as it appears in the fall and winter. 2. Perithecium with mycelium, *a a* between the cells of stem, and covered with filaments bearing spores, *b*, at their extremities. Section made in May. 3. Filaments and spores (*conidia*), more highly magnified. 4. Section through a cavity containing stylospores. After Farlow.

The disease is certainly getting a strong foothold in some sections, and it behooves every plum grower, even if he has but a single tree, to be upon the alert.

It is now nearly five years since the writer began a crusade against the disease, and, from the reports that come in, it is encouraging to see that the growers appreciate the danger that menaces them, and are acquiring the knowledge of its appearance necessary to enable them to combat it upon its manifestation. What is needed now is a united public sentiment against it that will secure prompt action upon the part of all.

While the destruction of the outside sources of contagion should not be neglected, it seems desirous that the trees should be kept in such a condition as will enable them to withstand the disease; hence, thorough cultivation and liberal quantities of mineral manure should be given the orchards. As severe outbreaks of the disease often follow years of full crops of fruit, it

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will be a wise precaution to prevent overcropping, and the consequent weakening of the trees, by a judicious thinning of the fruit.

As indicated above, whenever a knot appears it should be cut off, while still but partly developed, *and destroyed by fire.* The cut should be made several inches below the lowest point where any discoloration can be seen in the wood, in order to remove all of the tissues of the fungus and prevent its spread down the branches. If the knot is upon the trunk of the tree, while it might be economy to remove and burn the entire top of the tree, if not the tree itself, it can generally be prevented from spreading if the swelling is carefully pared away and the wound treated with tincture of iodine, which seems to have the power of destroying the tissues of the fungus without injuring the tree. The wound should then be covered with linseed oil paint. Good results have been found from the use of the oil alone but the treatment with iodine seems more efficient.

Cut off or treat the knots whenever they are found, but careful examinations of the trees should be made in the Spring and again in the Fall to prevent the knots that may have escaped attention during the Summer from developing spores.

To secure the proper attention to the destruction of the knots, a law was enacted by the last legislature, as a part of the Yellows law (which is given in this Bulletin under that heading). The intelligent and wide-awake fruit grower does not need to be compelled to destroy his knots, by legislative enactment, but he should avail himself of its aid in securing the destruction of the knots upon the trees of his criminally careless neighbor.

PLUM BLADDERS. (*Exoascus pruni.* Fuckl.)

The fruits of the European plums and both branches and fruit of American sorts are often attacked by a fungus causing them to swell up. The fruits in particular are greatly distended, the contents are destroyed, and only a hollow shell remains, hence the name. The diseased twigs and fruits should be removed and burned. While entire immunity may not be secured by spraying as for the rot and shot-hole fungus, with the Bordeaux mixture, there are no other known remedies.

THE PEACH AND PLUM ROT. (*Monilia fructigena.* Pers.)

Particularly in wet seasons this disease has caused frequent losses to the peach and plum growers, the entire crops in some cases being destroyed. The apricot and cherry also are subject to the same disease. It is most injurious to the early sorts, but few if any varieties are proof against it. In the case of the cherry and plum the foliage as well as the fruit is attacked and the young twigs, particularly of American varieties, may also be involved. Not only does the presence of moisture seem necessary for the germination of the spores, but the spread of this disease is in proportion to the humidity of the season. The appearance of the disease is familiar to all, but it may not be generally understood that the patches of yellowish-brown dust seen upon the surface are the spores, or seeds of the disease, by which it is disseminated. When two or more fruits grow so closely together that they touch, the sides in contact are generally covered with moisture, and the germination of the spores is hastened; it is a matter of general observation that if one fruit is attacked the rot always spreads to all fruits that touch it. By the proper thinning of the fruit, the rot is made less destruc-

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tive. From the fact that the early varieties of the peach seem most subject to the disease, many growers have given them up entirely. In seasons when damp, muggy weather prevails, it is doubtful if the rot can be entirely kept in check by fungicides, but under fairly favorable conditions, there will be little if any loss from this disease, if Bordeaux mixture is used as directed for the treatment of the peach curl, and of course there will be no additional expense. When we consider the loss that often occurs from even one of these diseases it should induce every fruit grower to make use of this simple and cheap remedy.

In case the month of July is wet and lowery, there will be danger that the early applications of Bordeaux mixture may not be sufficient to hold the rot in check, while in the case of the plum, the shot-hole fungus may need treatment. For late varieties that will not be harvested for six or eight weeks, the Bordeaux mixture may again be used, but for the August sorts it will be better to use the ammoniacal solution of copper carbonate, although this should not be used within three weeks of the time the fruit is to be gathered.

PEACH-LEAF CURL. (*Exoascus deformans.* Berk.)

This disease which is known to be of a fungus nature is in wet, cold seasons very destructive to the foliage of peach trees, often causing all of the older leaves to drop from the tree, and the result is that much of the fruit also falls. The tissues of the affected leaves become thick and later on are blistered and distorted. At first they are of a light olive color but, later on as the spores develop, they are covered with a whitish powder. It was at first thought that as the conditions that favored the appearance of the disease (wet, cold weather) were so unsuited to success in the application of fungicides, that at best they would prove only partially satisfactory, but although the past season was so wet during May and June that in some parts of the State the disease was quite troublesome the results were unexpectedly favorable. At the college little curl appeared, but along the lake shore many growers were considerably troubled and where tested the fungicides were of value in keeping the disease in subjection.

When in attendance at the summer meeting of the State Horticultural Society at Shelby it was my pleasure in company with others to visit many of the neighboring peach and plum orchards. The curl was quite prevalent, but where the trees were sprayed a marked difference was noticed. In the extensive orchard of A. Adams about one-half of the trees received a single application of Bordeaux mixture after the disease appeared, but at the time of our visit (June 15) the effect was very noticeable, as the loss of foliage and fruit was far less upon the sprayed trees. At our South Haven sub-station, as will be seen by the acompanying report of Pres. Lyon, the curl was almost completely held in check, although fully half of the leaves had fallen from unsprayed trees in the neighborhood.

With such a cheap and effective remedy at hand, this disease need not be especially feared. To secure the best results the trees should be thoroughly sprayed with Bordeaux mixture in the spring before the leaves start, the application should be repeated within a week after the petals have fallen, and a third application should be made in about three weeks. If very rainy a more frequent use of the fungicide may be necessary, and an

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additional application can often be used with profit, as, even if the curl is not particularly troublesome, the treatment will be found effective against the rot of the peach which in wet seasons is so destructive, and by the addition of Paris green the ravages of the curculio will be lessened.

SHOT-HOLE FUNGUS—(*Septoria prunî.*)

The disease to which this very distinctive name has been given has, during the past two years, caused the death of thousands of plum trees in the State of Michigan, and yet, had proper precautions been taken, they could have been saved at a cost of not over three cents per tree.

The leaves of plum trees during July and August are often found pierced with a number of holes about the size of a pinhead, the tissue which filled them having been destroyed by the above fungus, and the dead structure then dropped out.

In severe cases, the injury to the foliage is so great that all of the leaves upon the trees, except a few at the tips of the branches, drop off, generally before the middle of August. A tree thus denuded of its leaves is in a poor condition to ripen its growth and prepare for winter, and not only are the watery, unripened branches injured but the entire tree is often killed to the ground. If the ravages of the fungus can be checked, the foliage will be able to perform its functions, and the trees will in most cases survive the winter without injury.

As a rule, if the trees have been treated with Bordeaux mixture, as recommended for the plum rot, there will be but little injury from the disease. It will be well to spray young trees, that are not yet in bearing, about the middle of July and again early in August, and the spread of the disease can be almost entirely prevented.

PLUM AND PEACH SCAB.—(*Cladosporium carpophilum.*)

This fungus is in some seasons quite injurious to the fruits of both of these fruits, and it also attacks the leaves and tender shoots of the peach.

At the time the fruits begin to color, small greenish spots appear; as these spread the centers take on a brown and even a black appearance. When the spots are numerous they unite and may cover the entire surface of the fruits. The De Soto plum and Russian apricots seem particularly subject to this disease; in 1893 the crop was practically ruined by it. Its workings were not noticed until too late to test the efficacy of fungicides. Prof. Pammel reports the disease upon the increase in Iowa, and it may become generally troublesome.

BROWN SPOT (*Helminthosporium carpophilum.*)

In September, 1893, a basket of seedling peaches in a pedler's wagon was noticed to be badly spotted with some fungus, that although it had some slight resemblance to *Cladosporium*, was manifestly distinct from it. Superficial examination failed to reveal any specific spores and specimens were sent to Prof. Galloway of the Division of Vegetable Pathology at Washington, for identification. He was not familiar with it, however, and was not able to make out any distinctive spores. Dr. Beal had, however, independently obtained specimens of the disease and after long and careful search found the spores and was able to identify it as the above disease. The fungus seems to be quite superficial in its workings and the fruits

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were not noticeably distorted. Many of the fruits were badly spotted and in some cases nearly covered with yellowish brown scabs. From the fact that the disease was not more widely known it evidently has not been very destructive, but if it becomes distributed it may become quite injurious to our peach crop.

GATHERING AND MARKETING.

Even if a good crop is grown, success is not assured until it has been gathered and put upon the market, in fact success or failure will often depend upon the ability with which this is done.

From the fact that both of the fruits under discussion are of a decidedly perishable nature, great care must be taken to gather them at such a period that they will be still in good condition, when placed upon the market.

With the peach, for such markets as are likely to be supplied, the fruit should be gathered just as it is reaching a ripe condition, a period which can better be shown than described. The green color should be just disappearing from the under side of the fruit, giving way to a yellowish-white or flesh color, as the case might be. As an indication to the touch, the flesh of the upper side should give slightly, when pressed with the ball of the thumb. The latter sign is not infallible, but the former seldom ever fails. With a little experience, a man can judge of the condition of a peach without employing either method except occasionally as a test. Under no circumstances should the thumb nail be used to test the fruits, and every precaution should be taken not to bruise them. Taking a fruit lightly and yet firmly, between the thumb and fingers a slight twist of the hand will serve to separate it from its stem. The rule of "handling as if they are eggs" will not apply with peaches, since they need even greater care.

PACKAGES FOR PEACHES.

The packages best adapted for the shipping of peaches depend, first, upon the wants of the market and, second, upon the grade of fruit and the distance it is to be transported.

For a local market it is generally best to use either peck or fifth bushel baskets for the best quality of fruit, and the bushel or half bushel size for seconds. Much the same rule holds good when shipments are made by rail or boat. It is best, however, to study well the wants of a market and to use the size and style of package that is most in favor with the middlemen and the consumers, as, however it may be in other things, it will not pay to attempt to educate the taste of the public in the style or size of package to be used. With the packing, however, it is different, and an endeavor should be made to put up the fruit in such a way that it can be transported without unnecessary bruising, and at the same time be attractive to the eye. The packing, however, should be honest, and all the peaches should be of the grade indicated by the top layer.

Regarding the use of the fifth bushel and other sizes of packages that were brought out as "snides," it should be said that in some markets they are recognized as standard sizes and are sold on their merits. If the middlemen prefer to handle that size, and if the consumers desire it, the producer should by all means supply the demand, as, if the fruit is shipped in pecks, the jobber or retailer will quite likely repack it. The price being by

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the basket he will be a gainer to the extent of twenty-five per cent, which really belongs to the producer. On the other hand, where the best trade recognizes the peck basket only as a legitimate size, it will be very unwise to ship in fifths, as the shipments from parties who use peck baskets will receive first attention, while those in fifths which are here regarded as "snides" are sold for what they will bring.

No arbitrary rule can be given for the grading of peaches, but for an appreciative trade the number of grades should be two, if not three. On the other hand, in some markets and with some dealers, as much can be obtained when packed without being assorted, as they can when graded and put up in the most careful manner.

For the average market, after rejecting all decayed and badly injured fruits, two grades are all that it will be desirable to make. The method of grading will depend something upon the market, but, in a general way, the first grade should contain only large, well-colored peaches that are perfect in form and free from blemishes. All other marketable specimens should go into the second grade; the distinctive line between the second grade peaches and those that are to be rejected will depend upon the market and the abundance of the crop.

If a person can secure a reputation for the grading and perfect packing of his first-class peaches, his brand will secure him an advance of from ten to twenty-five cents per basket above his neighbors, who may have shipped just as good peaches, but for all that the dealer or purchaser may know, unless he inspects every package before buying, he has stuffed with "culls" and the price given will be sufficiently low to insure against loss. The grower who desires to work up a reputation and thus obtain this extra price should carefully brand his packages, showing in addition to his name and address, the grade of peaches contained in the package and a guarantee that the packing is honest. If he does this, and lives up to his representations, he may be sure of an advance over the market price, and in the case of a glut, when his neighbor may not get enough from his shipment to pay charges, he will be sure of a sale at a fairly remunerative price. Many growers do not place their names upon the packages in which the "seconds" are shipped, although the same guarantee of honest packing would have fully as good an effect with them, as with the first-class fruit, in securing its full value and a ready sale when the glut comes. Even if the packages do not have the name of the shipper upon them, they should bear a private mark that would be recognized by the commission merchant, or retailer, and enable him to guarantee the honest packing of the baskets.

The growers in the "peach belt" are as fast as possible releasing themselves from the grasp of the South Water street, Chicago, commission men, and are so far as possible seeking out markets for themselves. The shipments are generally made by express to consumers and retailers in country towns and small cities in non-peach-growing districts, and if well managed a desirable trade can be built up. For shipping in this way the first-class peaches only are used.

The so-called wagon trade is of considerable importance. This consists in the sales made to men who have driven, oftentimes, fifty or seventy-five miles, from points in Indiana or Illinois, perhaps, for the purpose of buying ten to forty bushels of peaches. They peddle them out on their way home, reserving enough for the use of themselves and their neighbors.

One should have some ready communication with his market. The growers in most sections of the "peach belt" can ship either by water to

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Chicago or Milwaukee, or by rail to all points. In this way they secure competition in rates, gentler handling of their shipments and more courteous treatment, when favors are requested or complaints made. In localities where one or more cars can be loaded in a day, very low transportation rates and prompt service can be secured, either by fast freight or by express. The thing most needed by the grower is a low express rate to small interior points on small lots.

For the purpose of securing market for the fruits and by coöperation obtaining the highest market prices, the so-called "Shippers' Exchanges" or similar organizations have been found very successful in some States, but although they have been formed at various shipping points in Michigan, through no fault of their own, they have not proved as successful as they should. Fairly successful in securing low rates of transportation, they have failed in raising the price obtained for fruit by guaranteeing the packing, through the selfishness of parties who persisted in using "snide" packages and stuffing them at that.

PICKING AND MARKETING THE PLUM.

The general rules given for the peach, apply also to the harvesting and packing of the plum, but need to be slightly modified in some of their details.

The plum for any except local markets will need to be picked slightly before it is ripe, the amount depending upon the length of time necessary for transportation.

The color, firmness, attachment to the branch, and the taste, are all employed in determining the fitness of a variety for market, but with the differences that exist in the long list of commercial sorts, no infallible description will be attempted as a guide for picking. A little practice will soon teach one the proper conditions.

In handling the plum, the same care is needed as for the peach, and particular attention should be paid to the preservation of the bloom. The usual packages for plums are the fifth or peck baskets or the ten pound Climax basket. The style, however, changes from year to year and differs with the market.

AGRICULTURAL COLLEGE,
January 25, 1894.

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A YEAR AMONG FRUITS.

Bulletin No. 104.

It is now five years since arrangements were made for a fruit testing sub-station at South Haven, in the midst of the great commercial fruit interests of the State, and the fifth annual report of the superintendent, Hon. T. T. Lyon, is appended. The fifteen acres at our disposal are closely planted with the leading tree and vine fruits hardy in this latitude; in making the selection an attempt has been made to secure all of the promising new varieties that are brought out, if possible, in advance of their introduction. As the first planting was done in 1888, with large additions in 1889, 1890 and down to 1893, many of the large fruits are as yet not in bearing, but an idea of the amount of work that has been done can be obtained from the report.

Under the skillful and painstaking care of Pres. Lyon, the plantation has been in splendid condition, and is well worthy of a visit from any one interested in pomology; all such will always find a welcome.

Attention is called to the following points in the bulletin:

First, The elaborate notes upon the varieties under test; as they give the unbiased opinion of one of the most experienced pomologists in the country, they are certainly worthy of careful study. The lists of peaches and grapes contain quite a number of Michigan seedlings that should be watched with interest.

Second, The methods used in combating the insects and diseases. Although the treatment was rather more thorough than would be used by commercial fruitgrowers (or than will be necessary a second year, so well are they in hand), the results have been so beneficial in the freedom of both foliage and fruit from their attack that all expense has been well repaid. In previous years, the injury from raspberry anthracnose, currant and gooseberry mildew, strawberry leaf-blight, peach curl and rot, plum rot and shot-hole fungus, pear and quince leaf-blight, and from various

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insects, has been quite severe, but the treatment given has sufficed to keep the trees and plants in almost perfect health.

It has for some years been known that the Bordeaux mixture and other copper compounds were reliable remedies for many fungous diseases, but although our previous experience upon a small scale had led us to believe them of value for strawberry leaf-blight, raspberry anthracnose and peach leaf-curl, the experiments at South Haven the past year have fully convinced us that they should be freely used upon these plants whenever the diseases are troublesome. As is well known, certain varieties of strawberries are much injured by leaf blight, but where they were properly sprayed the plants were practically free from the disease; the same thing was true of peach curl and of raspberry anthracnose.

Elaborate experiments were carried out upon several varieties of grapes, to ascertain the number of applications, and the time of making them, desirable in combating the various diseases to which they are subject. The black rot did not show itself, and there was but slight injury from other fungi. Attention is called to the results upon the Brighton, which was considerably troubled with powdery mildew; as the number of applications increased from none to five, the health of the plants improved in the same degree. Much of the benefit derived from the fungicides was undoubtedly due to the fact that all of the plants were sprayed before the growth started.

L. R. TAFT,
Horticulturist.

To Professor L. R. Taft, Horticulturist:

SIR—In submitting my report of operations for the season of 1893, at the South Haven fruit testing sub-experiment station, it seems convenient to consider the several classes of fruits in the order of their maturing.

The preceding season (1892) proved to be specially favorable for the development of the various species of fungi, the ravages of which proved more than usually injurious. The entire plantation was given a spraying during the late autumn, after the foliage had fallen, and prior to the advent of freezing weather, for the purpose of destroying the winter or resting spores, and thus, at least to some extent, preventing their development the following season.

The apparent effect of such fall spraying, as well as of those applied during the present season, will be noticed in connection with each class of fruits in its order, as will also the depredations of insects and the remedies applied.

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STRAWBERRIES—(*Fragaria*).

The plat of which the following is a record was planted in the spring of 1892. The stand of each variety, when full, consisted of twenty-six plants, of which one-half were kept in hills, by the removal of all runners, while the remaining half were allowed to form a matted row.

Very soon after the planting had been completed, a series of almost continuous rains commenced; the showers followed each other in such rapid succession that the soil remained saturated for a considerable period, while the recently set plants were gaining a hold upon the soil.

The enfeeblement consequent upon this trying condition, occurring at so critical a juncture, proved so serious that, followed as it was by drouth in late summer and early autumn, many, if not most varieties, failed to fully recover their pristine vigor; the result being fewer crowns, in the case of hills, and more limited stands of plants in matted rows, though the latter obviously overcame such check more promptly than did the larger hill plants, a circumstance which may be supposed to account for the fact that the relative productiveness of varieties under hill and matted row culture is very generally reversed, as compared with that of 1891, at which time no serious checks upon the development of the plants occurred during their season of growth.

The present plat was treated to a spray of Bordeaux mixture (4 lbs. copper sulphate, 3 lbs. lime and 32 gallons of water), prior to the advent of freezing weather last fall, and it was repeated on the sixth of April last. Apparently from this cause, the entire plat has been free from attacks of fungi throughout the season—at least till the 29th of July when it was plowed under.

Whether from the same cause or otherwise, the plat was also almost wholly free from the depredations of insects. Only a very few leaf rollers were observed, which were at once destroyed when discovered.

It will be observed that in the naming of varieties we have applied the rules of nomenclature of the American Pomological Society, and the practice of the National Division of Pomology under them; in case of possible doubt, inserting the objectionable word in parenthesis as a synonym.

We omit all tabulated descriptions of varieties, since such must necessarily be too brief and imperfect to be valuable for identification.

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STRAWBERRIES—(*Fragaria*).

Numbers.	Names.	b, Bi-sexual; s p, nearly pistillate; p, pistillate.	Origin.	First planted.	First bloom.	First picking.	Last picking.	Vigor—Scale, 1 to 10.	Ounces. Product with hill culture.	Ounces. Product in matted row.	
1	Accomac	b	Del.	1892	May 22	June 21	July 7	3	29	20	
2	Afton	p	N. Y.	1892	" 25	" 21	" 3	5	14	16	
3	Alabama	b	Ala.	1890	" 22	" 21	" 7	5	22	20	
4	Alpha	b	Ont.	1881	" 22	" 21	" 7	6	30	18	
5	American (Great)	b	N. J.	1878	" 20	" 17	" 17	6	54	192	
6	Atlantic	b	N. J.	1890	" 22	" 21	" 14	8	86	197	
7	Auburn	p	N. Y.	1892	" 26	" 21	" 12	9	29	74	Not fully tested.
8	Augwick	p		1892	" 22	" 21	" 14	9	44	181	New.
9	Banquet	p	N. Y.	1892	" 10	" 8	" 14	8	50	160	Needs further trial.
10	Barton (Eclipse)	p	Div. Pom.	1891	" 22	" 23	" 14	8	63	130	
11	Beder Wood	b	Ill.	1890	" 12	" 22	" 14	8	100	485	
12	Beebe	b	N. J.	1892	" 22	" 23	" 5				Planted too late.
13	Belmont	b	Mass.	1885	" 22	" 23	" 10	7	40	79	
14	Bessie	p	Ala.	1890	" 15	" 16	" 3	10	88	79	
15	Belts (3)	b		1892	" 12	" 17	" 14	10	70	32	Needs further trial.
16	Beauty	b	Ind.	1892	" 17	" 21	" 5	6	29	65	
17	Beverly	b	Mass.	1892				3			Try further.
18	Bidwell	b	Mich.	1876	May 22	June 21	July 10	6	45	42	
19	Boynton	p	Ohio	1891	" 22			5			Needs a longer trial.
20	Brunette	b	Ind.	1892	" 19	June 16	July 5	7	24	29	Imperfectly tested.
21	Bubach (5)	p	Ill.	1888	" 23	" 21	" 12	8	73	159	
22	Bubach (24)	b	Ill.	1890	" 19	" 19	" 3	5	21	75	
23	Bubach (132)	b	Ill.	1890	" 17	" 19	" 7	7	35	90	
24	Bubach (137)	b	Ill.	1890	" 12	" 17	" 7	5	35	66	
25	Burt	b	N. Y.	1859	" 19	" 19	" 7	8	64	174	Much like Wilson.
26	California		Del.	1891							Untested.
27	Cameronian	b	Ohio	1892	May 22	June 23	July 12	9	46	91	Needs further trial.
28	Centennial (Ohio)	b	Ohio	1892	" 24	" 23	" 17	5	74	194	Promising.
29	Charleston	b	Ohio	1890	" 22	" 23	" 12	4	13	12	
30	Clark	b	Md.	1892	" 10	" 17	June 30	8	41	38	Try further.
31	Cleveland (Mrs.)	p	Ohio	1888	" 17	" 19	July 10	6	56	83	Not productive enough.
32	Clingto	s b	Ohio	1890	" 12	" 23	" 10	4	18	33	
33	Cloud	p	La.	1888	" 28	" 23	" 10	7	62	135	Southern.
34	Covell	b	N. J.	1888	" 10	" 16	June 30	6	63	93	
35	Crawford	b	Ohio	1889	" 12	" 21	July 7	7	32		Plants lacking.
36	Crescent	p	Conn.	1880	" 17	" 21	" 7	7	43	227	
37	Cumberland	b	Penn.	1880	" 24	" 21	" 14	9	56	136	Large; lacks color.
38	Curtis (15)	b	Ill.	1892	" 15	" 21	" 5	5	41	31	
39	Curtis (159)	p	Ill.	1892	" 20	" 21	" 12	8	35	126	
40	Daisy	p	Ohio	1890	" 24	" 21	" 7	6	65	71	
41	Dayton		Ohio	1892	" 22	" 21	June 30	8	10		But imperfectly tested.
42	Dew	b	Mich.	1889	" 29	" 26	July 12	10	30	43	Large; late.
43	Dutter	b	Ind.	1889	" 24	" 26	" 12	6	27	38	Uncertain value.
44	Edgar	p	Ill.	1890	" 20	" 23	" 17	7	101	168	New; promising.
45	Engle (1)	b	Mich.	1890	" 8	" 21	" 17	8	8	120	Of Paw Paw, Michigan.
46	Enhance	b	Ohio	1890	" 12	" 19	" 10	6	88	50	Usually very productive.
47	Estelle	b	Mich.	1891	" 20	" 26	" 17	6	36	87	From Paw Paw, Michigan.
48	Eureka	p	Ohio	1888	" 22	" 26	" 14	7	78	131	
49	Fairmount	b	N. J.	1891	" 20	" 21	" 10	7	76	163	Promising.
50	Farnsworth	b	Ohio	1891	" 22	" 21	" 14	5	27	104	
51	Felton	b	Ohio	1890	" 22	" 26	" 17	7	56	84	
52	Florence	b	Ohio	1888	" 22	" 21	" 14	6	38	38	
53	Gandy	b	N. J.	1887	" 24	" 26	" 14	7	13	112	Popular; late.
54	Gem (Nehring)	p	Ill.	1890	" 17	" 19	" 12	10	48	79	Usually productive.
55	Glendale	b	Ohio	1882	" 22	" 23	" 12	8	43	135	Old; late.
56	Gillespie	b	Ohio	1891	" 12	" 21	" 7	5	38	28	Needs further trial.

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STRAWBERRIES—CONTINUED.

Numbers.	Names.	b, bi-sexual; n p, nearly pistillate; p, pistillate.	Origin.	First planted.	First bloom.	First picking.	Last picking.	Vigor—Scale, 1 to 10.	Ounces. Product with hill culture.	Ounces. Product in matted row.	
57	Greenville	p	Ohio	1891	May 19	June 23	July 12	7	42	147	Promising.
58	Hampden	p	Mass.	1889	" 20	" 26	" 7	5	52	---	
59	Hatfield	b	N. J.	1890	" 20	" 21	" 7	7	11	57	
60	Hattie (Jones)	p	Ind.	1892	" 20	" 28	" 12	7	121	93	Promises well.
61	Haverland	p	N. J.	1887	" 19	" 21	" 12	7	81	179	Valuable.
62	Henderson	b	N. J.	1888	" 26	" 28	" 7	5	18	17	Superior quality.
63	Hermit	b	Ohio	1892	" 19	" 23	" 12	9	54	120	Promising.
64	Hinman	b	.....	1890	" 22	" 21	" 14	8	64	69	
65	Hoard	b	Wis.	1888	" 19	" 23	" 10	8	51	135	Worthy of trial.
66	Hoffman	b	N. J.	1889	" 22	" 21	" 5	5	9	29	Southern.
67	Holyoke	b	Mass.	1891	" 15	" 21	" 12	6	86	194	Try further.
68	Howard	p	Mass.	1892	" 26	" 21	" 5	6	16	92	
69	Hugo	b	N. J.	1891	" 12	" 16	" 7	7	118	147	Named for Victor Hugo.
70	Huntsman	b	Mo.	1892	" 15	" 17	" 3	8	15	31	New.
71	Hyslop	---	Del.	1892	.....	.....	.....	4	---	---	Not fruited.
72	Iowa (Beauty)	---	Iowa	1892	.....	.....	.....	5	---	---	Not fruited.
73	Ivanhoe	b	Ohio	1889	May 22	June 21	July 7	6	53	101	
74	Jessie	b	Wis.	1889	" 15	" 21	" 10	5	63	89	
75	Jones	b	Ind.	1892	" 19	" 21	" 5	7	20	41	Need longer trial.
76	Jucunda Improved	b	N. J.	1890	" 30	" 23	" 12	7	61	56	Scarcely improved.
77	Katie	b	Ind.	1892	" 22	" 21	" 12	7	30	50	Try further.
78	Kentucky	b	Ken.	1876	" 24	" 26	" 17	10	70	95	Old; late.
79	Leader	b	Ohio	1892	" 12	" 16	" 10	7	39	41	Needs further trial.
80	Lehigh	p	Pa.	1891	" 12	" 16	" 7	7	65	123	Promises well.
81	Leroy	---	Ind.	1892	" 17	" 23	" 12	6	43	78	
82	Leviathan	b	Ohio	1892	" 19	" 16	" 5	8	16	11	Imperfectly tested.
83	Lida	p	N. J.	1886	" 10	" 16	" 10	4	38	41	
84	Lillie (Monroe)	b	Cal.	1891	" 19	" 23	" 7	5	27	43	From California.
85	Lincoln	p	Del.	1892	" 19	" 21	" 7	7	70	216	May be a re-introduction.
86	Logan	b	Ind.	1888	" 22	" 21	" 12	6	48	76	
87	Louise	b	N. Y.	1889	" 31	" 26	" 12	6	51	43	Has desirable qualities.
88	Lovett	b	N. J.	1891	" 24	" 21	" 12	7	57	138	Of medium season.
89	Mammoth	b	N. J.	.....	" 24	" 23	" 17	8	53	87	
90	Manchester	p	N. J.	1850	" 17	" 23	" 17	6	137	280	Old; valuable.
91	Mark	b	Ohio	1890	" 22	" 23	" 17	5	37	64	
92	Martha	n p	Minn.	1887	" 17	" 21	" 12	7	139	108	
93	Miami	n p	Ohio	1889	" 22	" 21	" 14	6	67	86	
94	Miller	b	N. J.	1890	" 20	" 23	" 12	7	49	63	
95	Michel	b	Ark.	1890	" 15	" 16	" 5	8	65	105	Of little value here.
96	Miner	b	N. J.	1878	" 22	" 23	" 10	7	65	164	
97	Monarch (Ohio)	b	Ohio	1891	" 20	" 23	" 7	6	25	102	
98	Monmouth	b	N. J.	1888	" 26	" 23	" 14	6	44	79	
99	Moore	b	Mich.	1889	" 27	" 23	" 10	6	35	99	
100	Muskingum	b	Ohio	1892	" 24	" 21	" 12	6	28	92	Needs further trial.
101	Mystic	b	Ind.	1892	" 20	" 26	" 10	6	28	36	Try further.
102	Neptune	p	Ohio	1890	" 26	" 26	" 17	6	47	122	
103	Novelty (White)	b	N. J.	1892	" 22	" 16	June 21	2	8	---	A fancy variety, *F. vesca*
104	Oliver	b	Ill.	1890	" 22	" 26	July 17	9	65	118	
105	Omega	p	N. J.	1891	" 22	" 21	" 10	9	86	116	
106	Oregon (Everbearing)	p	Ohio	1891	" 15	" 21	" 17	7	66	173	Try further.
107	Osceola (Michel)	b	Mo.	1890	" 9	" 21	June 26	8	19	58	Identical with Michel.
108	Pacific (Great)	p	Ill.	1890	" 22	" 22	July 14	8	109	137	A market variety.
109	Parker Earle	b	Texas	1889	" 24	" 23	" 17	8	82	127	One of the best.
110	Parry	b	N. J.	1886	" 22	" 23	" 14	6	38	89	Large; high quality.
111	Pearl	b	N. J.	1888	" 19	" 23	" 14	8	130	115	
112	Pineapple	b	Ohio	1889	" 22	" 23	" 7	7	32	66	

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STRAWBERRIES—CONTINUED.

Numbers.	Names.	b, bi-sexual; n p, nearly pistillate; p, pistillate.	Origin.	First planted.	First bloom.	First picking.	Last picking.	Vigor—Scale, 1 to 10.	Ounces. Product with hill culture.	Ounces. Product in matted row.	
113	Porter	b	N. J.	1890	May 27	June 21	July 10	6	64	75	
114	Price	b	N. Y.	1892	" 20	" 21	" 5	9	48	58	Try further.
115	Princess	p	Minn.	1892	" 27	" 23	" 10	6	35	97	Give further trial.
116	Prince (of Berries)	b	N. J.	1888	" 22	" 17	" 7	4	19	50	Excellent; unprofitable.
117	Puritan	p	Ohio	1887	" 12	" 17	" 7	6	33	19	
118	Putnam (Gen'l)	b	Ct.	1890	" 19	" 21	" 12	10	62	105	Promising.
119	Regina	p	Ala.	1890	" 29	" 26	" 14	9	25	63	
120	Rusk	n p	Ill.	1889	" 12	" 21	" 12	7	89	160	Market variety.
121	Sadie	p	Ohio	1890	" 9	" 16	" 7	8	54	187	
122	Sandoval	b	Ill.	1890	" 12	" 21	" 14	4	51	126	Warfield, No. 1.
123	Saunders	b	Ont.	1889	" 26	" 21	" 10	9	83	178	Valuable.
124	Scarlet Ball	p		1892	" 29	" 26	" 14	9	33	35	Needs longer trial.
125	Sharpless	b	Pa.	1878	" 24	" 23	" 12	8	30	80	
126	Shaw	b	Ont.	1890	" 24	" 23	" 14	7	55	86	
127	Shuster	b	N. J.	1891	" 23	" 21	" 10	6	74	157	Valued east.
128	Southard	b	Ct.	1892	" 15	" 19	" 3	5	37	67	
129	Speece	b	Mo.	1890	" 20	" 19	" 10	7	102	122	Promising.
130	Standard	b	Ct.	1892	" 12	" 17	" 3	6	41	...	Try more fully.
131	Stayman (1)	n p	Kas.	1890	" 26	" 21	" 10	9	104	156	Good.
132	Stayman (2)	n p	Kas.	1890	" 17	" 21	" 10	8	78	88	
133	Stevens	b	Ala.	1890	" 12	" 17	" 3	7	38	86	
134	Sucker (State)	b	Ill.	1890	" 29	" 23	" 12	7	26	49	
135	Surprise	b	Del.	1892	" 30	" 26	June 30	7	17	...	May be the old Surprise.
136	Swindle	p	Vt.	1892	" 22	" 23	July 12	6	124	124	An unfortunate name.
137	Thompson (1)	b	Ohio	1890	" 22	" 23	" 5	3	12	6	
138	Thompson (4)	b	Ohio	1890	" 12	" 19	" 10	8	50	64	
139	Thompson (5)	b	Ohio	1890	" 15	" 21	.....	7	...	...	
140	Thompson (7)	p	Ohio	1890	" 19	" 21	July 12	6	85	185	Promising.
141	Thompson (8)	p	Ohio	1890	" 12	" 21	" 12	8	70	110	
142	Thompson (9)	b	Ohio	1890	" 19	" 21	" 3	7	52	60	
143	Thompson (17)	p	Ohio	1890	" 20	" 26	" 12	6	39	33	
144	Thompson (25)	b	Ohio	1890	" 28	" 23	" 12	7	57	83	
145	Thompson (26)	p	Ohio	1890	" 22	" 23	" 12	8	46	187	Promising.
146	Thompson (31)	p	Ohio	1890	" 20	" 21	" 10	9	96	213	"
147	Thompson (34)	p	Ohio	1890	" 19	" 21	" 10	5	95	78	
148	Thirty-one	b	Ind.	1892	" 22	" 23	" 12	8	34	72	
149	Tippecanoe	b	Ind.	1890	" 17	" 19	" 5	9	35	78	
150	Townsend (2)	b	Ohio	1888	" 24	" 26	" 10	7	15	39	
151	Townsend (3)	p	Ohio	1888	" 24	" 23	" 10	6	47	76	
152	Townsend (19)	p	Ohio	1888	" 19	" 21	" 12	8	118	183	Promises well.
153	Townsend (20)	p	Ohio	1888	" 29	" 23	" 12	6	73	142	
154	Triomphe (de Gand)	b	Belg.	1876	" 27	" 26	" 17	7	41	57	
155	Vernon (Mt.)	b	Kas.	1877	" 19	" 21	" 14	...	53	122	
156	Vick	b	Mo.	1878	" 22	" 23	" 10	6	97	206	Fruit lacks size.
157	Viola	b	Ohio	1890	.....	.....	.....	7	...	...	Not fruited.
158	Waldron	p	Ohio	1891	May 20	June 17	July 7	5	27	43	Try further.
159	Walton	p	N. J.	1890	" 20	" 23	" 14	6	51	130	Promises well.
160	Warfield (2)	p	Ill.	1890	" 20	" 21	" 10	9	94	349	Well known.
161	Westbrook	p	N. Y.	1891	" 15	" 17	June 30	7	25	75	
162	Weston	p	Wis.	1891	" 29	" 23	July 12	5	37	62	Or Blue Vine.
163	Williams	b	Ohio	1892	" 29	" 21	" 14	8	56	152	Very promising.
164	Wilson	b	N. Y.	1876	" 15	" 21	" 12	8	124	168	Old; well known.
165	Windsor	p	Mich.	1880	" 17	" 17	" 14	6	96	125	Old; well known.
166	Woolverton	b	Ont.	1891	" 17	" 16	" 7	9	33	41	Give it a better trial.
167	Yale	b	Ct.	1890	" 24	" 23	" 14	8	44	49	Valued at the east.

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Brief notices are appended of such varieties only as have yielded not less than one hundred and fifty ounces of fruit from a row of thirteen plants, either in hills or in a matted row.

American (Great American), bisexual; originated in New Jersey. It was exhibited, by the originator, at the Centennial Exposition, where it received the highest commendation. It originated under high cultivation and has only proved satisfactory when grown under similar conditions.

Atlantic, bisexual, is a comparatively old variety which, though fairly productive and generally acceptable, has not gained a high standing, so far as profitableness is concerned.

Augwick, pistillate, is but recently introduced. The plant is vigorous and productive, and the berry large, firm, and of medium quality. It has only fruited here this season.

Banquet, pistillate, is new, having only fruited here this season. The plant is vigorous and fairly productive, and the fruit of medium size and quality.

Beder Wood, bisexual, has now fruited here three years, and, both here and elsewhere has won high reputation for vigor and productiveness. In form, color, firmness and quality, it promises well as a market berry. Origin, Illinois.

Centennial (Ohio Centennial), bisexual, is a seedling from southwestern Ohio, and was so named from having first fruited during Ohio's centennial year. It is vigorous and fairly productive, and the fruit quite large, and of much more than average quality. It promises value for market purposes.

Crescent, pistillate, has been too long and favorably known to require a lengthy notice. Too soft for distant marketing, its hardiness, vigor and great productiveness render it desirable for near markets, though it is, to a considerable extent, confined to a low grade of cultivation.

Edgar (Edgar Queen), pistillate, is a fairly vigorous and productive plant; named for Edgar county, Ill., its place of origin. It is comparatively new, and has not yet a well established reputation. The fruit is large, of good form, attractive color; of high quality for so large a fruit.

Fairmount, bisexual, originated in New Jersey; was received for trial from the National Division of Pomology, during the hot, dry summer of 1890. We have been unable to fruit it satisfactorily till this season. The plant is of fully average vigor, and, so far, is fairly productive. Size, above medium; quality, medium.

Haverland, pistillate, introduced several years since, as larger and of higher quality than Crescent, as well as its rival in productiveness, has scarcely verified this latter claim and, either for that reason or for the less satisfactory character of the plant, the variety has not acquired the anticipated popularity with commercial planters.

Holyoke (Mount Holyoke), bisexual, although received as early as 1891, has not been in condition to satisfactorily manifest its qualities till the present season. So far, the plant seems to possess more than average vigor and productiveness. The fruit also ranks high, so far as both size and quality are concerned.

Hugo (Victor Hugo), bisexual, originated in New Jersey, but was received for trial from the Division of Pomology. The plant is very vigorous, and of more than medium productiveness. The fruit is large to very large, and of satisfactory form, color and quality. So far it seems to be well worthy of trial as a market variety.

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Lincoln, pistillate, is of more than average vigor, and very productive; fruit large, color attractive, but of scarcely medium quality. In the absence of a history of its origin, its tendency to grow misshapen or cockscombed fruits would seem to warrant the suspicion that it may be merely a re-introduction of the President Lincoln of the previous decade.

Manchester, pistillate, is too well known to require extended notice. Inclined, as it is, to overbear, if in good soil, with high culture and a renewal of the plantation after each full crop, it proves eminently profitable.

Miner, bisexual, though an old and productive variety, under favorable conditions, may now be properly laid aside in favor of newer and more desirable varieties.

Oregon (Oregon Everbearing), pistillate, hails from Ohio. Whatever its habit may be in its original locality, it is not a continuous bearer here, although the plant is vigorous and fairly productive in the usual season of this fruit. In size and quality, it is fully medium. This is its first fruiting here, and improved conditions in the future may develop more favorable results.

Rusk (Lady Rusk), nearly pistillate, was received from Illinois in 1889. In vigor of plant it is above medium. In productiveness it scarcely realizes the commercial requirement of the day. Fruit of more than medium size, firm, of good form and color, and of medium quality.

Sadie, pistillate, is vigorous, and has, this season, proved more than usually productive. The fruit is of less than medium size, and of medium quality and texture.

Saunders, bisexual, is a very vigorous and productive plant; originated by John Little of Ontario and named for one of the most noted horticulturists of the Dominion. In size, quality and firmness, it is quite above medium. It is worthy of extensive trial as a market berry.

Shuster (Shuster's Gem), nearly pistillate, is a popular variety in some parts of the east, though apparently less in favor at the west. Here the plant is above medium in vigor and productiveness, and slightly so also in size of fruit, though of only medium firmness and quality.

Stayman (No. 1), nearly pistillate, is very vigorous and productive; of only medium size and scarcely of medium quality. It is probably more at home in its native Kansas.

Thompson (No. 7), pistillate, comes to us from Ohio. It has not been favorably conditioned heretofore. This season it has proved quite productive; above medium in vigor, quality and firmness, though of only medium size.

Thompson (No. 26), pistillate, from the same source with the foregoing, has more vigor of plant and rather larger fruit, of only medium firmness, and quite low in quality.

Thompson (No. 31), pistillate, is vigorous in plant and large in fruit, but only medium in texture and quality. Its more than usual productiveness and size render it desirable for a near market.

Townsend (No. 19), pistillate, has, this season, shown more than medium vigor and productiveness. The fruit is large, though only medium in texture and quality.

Vick (James Vick), bisexual, is a low growing, very hardy plant, of scarcely more than medium vigor, which, this season, has fairly exceeded itself in productiveness. The fruit, though rich and bright in color, is of less than medium size, though of firm texture and high flavor.

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Warfield (No. 2), pistillate, is too well and favorably known to require description. It is generally prized as a market fruit.

Williams, bisexual, is vigorous, and of more than average productiveness. The fruit is large, firm, and of more than medium quality. It may be regarded as a promising variety for both home use and market.

Wilson, bisexual. This old and once universally popular variety is noticed here, mainly as a medium for comparison. When well grown, and free from fungous diseases, it is yet fairly productive, and, when allowed to thoroughly ripen upon the plant, it has even yet few, if any, superiors, all things considered.

RASPBERRIES (*Rubus*).

So many plants, in the trial plat of raspberries, were either killed or seriously injured by the persistent rainy weather of the spring of 1892, that although those remaining have generally recovered quite rapidly, and are now generally in thrifty condition, there are so many vacancies and such unevenness in the size and fruiting condition of the remaining plants that a comparison of actual products would afford but an imperfect and even erroneous idea of the relative productiveness of the varieties when under equivalent conditions. For this reason the productiveness of the several varieties is estimated upon a scale of 1 to 10.

The plat of raspberries was included in the general spraying with Bordeaux mixture of the usual strength (4 pounds copper sulphate, 3 pounds of lime and 32 gallons of water) applied to the plantation late last fall, with the purpose to destroy, as far as possible, the winter spores of fungi.

A spray was again given on the 3d of April last, prior to the commencement of the season's growth, with the same material and strength.

This was repeated on April 24th, with the same mixture, and with the addition of two ounces of Paris green for each 32 gallons of water.

On the 9th of May the plat received a final spray, with a still weaker solution, consisting of 2 pounds of copper sulphate, 1½ pounds of lime, and 2 ounces of Paris green, in 22 gallons of water.

Early last spring all canes, whether new or old, seriously affected with anthracnose were cut away and burned.

Whether as the result of these sprayings and pruning, or otherwise, scarcely a trace of anthracnose has been visible upon the growths of this season, while the foliage has remained perfect throughout the entire period, and neither the attacks of fungi nor the depredations of insects have at any time proved troublesome.

Dry weather and extreme heat during the ripening season occasioned the blasting or withering of more or less of the immature fruit of several varieties.

1. *Rubus Idæus.*

Varieties of European origin.

Number.	Name.	Origin.	Planted.	First bloom.	First ripe fruit.	Productiveness, Scale, 1 to 10.	Remarks.
1	Herstine	Penn.	1888	June 12.	July 6.	6	Excellent; requires protection.
2	Superb	N. J.	1888	" 13.	" 19.	4	Hardy; fruit large, dark purple.

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2. *Rubus neglectus.*

Botanists include, in this species, several varieties, by many assumed to be hybrids between *Occidentalis* and other species.

Number.	Name.	Origin.	Planted.	First bloom.	First ripe fruit.	Productiveness, Scale, 1 to 10.	Remarks.
1	Caroline	N. Y.	1888	June 12.	July 10.	10	Yellow; hardy; very productive.
2	Grieve	Kan.	1890	" 12.	" 10.	8	Roots by both tips and suckers.
3	Muskingum	Ohio	1890	" 15.	" 14.	10	Very vigorous; new; valuable.
4	Reliance	N. J.	1888	" 12.	" 12.	8	Very hardy; dark; purple.
5	Shaffer	N. Y.	1888	" 15.	" 14.	9	Tip rooting; large; dark purple.

3. *Rubus occidentalis.*

Black and yellow tip-rooting.

Number.	Name.	Origin.	Planted.	First bloom.	First ripe fruit.	Productiveness. Scale, 1 to 10.	Remarks.
1	Ada	Ohio	1888	June 15.	July 17.	6	So far is not valuable.
2	American Everbearing	Ohio	1892	.....	.....	.....	Has not yet fruited.
3	Beebe	N. Y.	1888	June 10.	July 10.	9	Yellow; unsightly if overripe.
4	Canada	Ont.	1891	" 13.	" 12.	6	Of doubtful value.
5	Carman	Conn.	1888	" 10.	" 8.	8	Good; but not relatively profitable.
6	Centennial	.....	1888	" 12.	" 12.	8	Not relatively profitable.
7	Conrath (Early)	Mich.	1891	" 15.	" 15.	9	Highly promising.
8	Cromwell	Conn.	1888	" 10.	" 10.	5	Injured by last year's wet.
9	Doolittle	N. Y.	1888	" 10.	" 8.	5	Generally profitable.
10	Doomore	Ohio	1888	" 12.	" 10.	4	Is unprofitable.
11	Earhart	Ill.	1888	" 10.	" 8.	8	Yields a second crop in autumn.
12	Farnsworth	Ohio	1891	.....	" 12.	3	Promising; needs further trial.
13	Gregg	Ind.	1888	June 14.	" 29.	....	Badly injured last year.
14	Hathaway (1)	Mich.	1891	.....	.....	....	Not yet fruited.
15	Hathaway (2)	Mich.	1891	.....	.....	....	Not yet fruited.
16	Hilborn	Ont.	1888	June 14.	July 21.	....	Badly injured by last year's wet.
17	Hopkins	Mo.	1888	" 12.	" 10.	5	Suffered from wet last year.
18	Idaho	Ohio?	1889	" 13.	" 17.	4	Badly killed last year.
19	Indiana	Ind.	1888	" 10.	" 8.	4	Badly injured last year.
20	Johnston (Sweet)	N. Y.	1888	" 13.	" 14.	....	Nearly ruined last year.
21	Kansas	Kan.	1889	" 13.	" 19.	2	Nearly ruined last year.
22	Lovett (Early)	N. J.	1892	.....	.....	....	Not yet fruited.
23	Mammoth Cluster	N. Y.	1888	June 10.	July 14.	6	Plants considerably injured.
24	Mohler	Ohio	1892	.....	.....	....	A few fruits on current year's canes.
25	Nemaha	Neb.	1888	.....	.....	....	Nearly ruined by wet last year.
26	Ohio	N. Y.	1888	June 10.	July 10.	10	Very productive, too seedy.
27	Older	N. J.	1891	.....	" 12.	....	Fruited but slightly.
28	Palmer	Ohio	1890	June 10.	" 8.	10	The best early blackcap.
29	Progress	N. J.	1890	.....	.....	....	No fruit this year.
30	Rundell	Mich.	1890	June 10.	July 12.	10	A reproduction of Beebe.
31	Smith (Giant)	Ont.	1889	" 13.	" 17.	10	Very vigorous and productive.
32	Souhegan	N. E.	1888	" 10.	" 7.	6	Usually an excellent early variety.
33	Surrey	Ohio	1889	" 13.	" 20.	1	But imperfectly tested.
34	Sweet Home	Ohio	1890	" 14.	" 15.	2	So far, not promising.
35	Tyler	.....	1888	" 10.	" 8.	7	Practically identical with Souhegan.
36	Virginia	Ohio	1889	" 10.	" 10.	6	Not promising, so far.
37	Winona	Ohio	1891	" 14.	" 17.	....	Was nearly ruined last season by wet.

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4. *Rubus phœnicolasius.*

Number.	Name.	Origin.	Planted.	First bloom.	First ripe fruit.	Productiveness. Scale, 1 to 10.	Remarks.
1	Japanese Wineberry	Japan	1891	June 27	.....	1	Worthless except for the beauty of its bloom and foliage.

5. *Rubus strigosus.*

Number.	Name.	Origin.	Planted.	First bloom.	First ripe fruit.	Productiveness. Scale, 1 to 10.	Remarks.
1	Brandywine	Penn.	1888	June 15	July 10	9	Hardy. A good market variety.
2	Church (Royal Church)	Ohio	1892	" 14	" 17	1	Has not yet shown its true quality.
3	Cuthbert	N. Y.	1888	" 17	" 11	8	Has no superior in its class.
4	Early King	Va.?	1893	.....	.....	.....	Not yet fruited.
5	Eastern King	N. E.	1888	June 12	July 10	7	A good family berry.
6	Gladstone	N. Y.	1892	" 14	" 14	5	Needs further trial.
7	Golden Queen	N. J.	1888	" 15	" 14	8	Excellent for home use.
8	Hansell	N. J.	1888	" 12	" 8	6	One of the earliest.
9	Marlboro	N. Y.	1888	" 12	" 10	4	Next to Cuthbert for market.
10	Reder	Mich.	1888	" 12	" 10	4	Large, bright colored, high quality.
11	Scarlet Gem	.....	1888	" 12	" 10	6	Beautiful; but not relatively profitable.
12	Thompson	Ohio	1888	" 12	" 8	9	A good early variety.
13	Thwack	.....	1892	" 18	" 15	1	Vigorous, productive, poor in quality.
14	Turner	Ill.	1888	" 12	" 10	4	Very hardy; canes without spines.

Notices are appended of the more desirable varieties, also of other more recent ones not yet fully tested.

BLACK OR YELLOW CAPS.—TIP-ROOTING.

Beebe—A yellow variety, very productive; of fair quality if used promptly, but if allowed to become overripe, the color becomes dark and forbidding, with loss of flavor.

Rundell (the name of the originator), a more recent seedling from southwestern Michigan, is merely a reproduction of the Beebe, with the same general characteristics.

Cromwell has now been several years before the public, and seems to be winning a good reputation as an early blackcap, ripening nearly with Tyler, and surely quite as early as Doolittle.

Doolittle was the forerunner, introducing the blackcaps to cultivation. It even yet maintains a creditable standing among the various rivals which have since arisen to contest with it for popular favor.

Earhart produces a light crop at the usual blackberry season, and also a second crop in autumn, upon the canes of the current season's growth. It may be desirable in the home plat, as a means of supplying this fruit out of the usual season.

Farnsworth, a recent variety from Ohio, has only fruited here this sea-

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son. It gives indications of value, as a fruit of medium season, for both the home and market.

Gregg is too well known as a profitable, strictly market variety to require special notice. Aside from its dense pubescence and rather low quality, its chief fault is lack of hardiness.

Hilborn has not, so far, acquired a wide reputation as either a family or market variety, although, to the writer's apprehension, it deserves a position nearly or quite at the head of the list, so far as quality is concerned.

Nemaha is a reproduction of the Gregg, with improved hardiness, as alleged by those who claim to have thoroughly tested it.

Ohio is popular as a hardy, vigorous and very productive variety. It is specially commended for its large, proportionate yield of the dried product; but it is doubtless true that the increased yield consists not of dried pulp, but of seeds instead.

Palmer, origin Ohio, proves to be early for a blackcap, and one of the finest and most vigorous and productive of its season.

Smith (Smith's Giant), so far, has proved to be exceedingly vigorous and very productive. It hails from Ontario, which may be taken as assurance of its hardiness.

Souhegan and Tyler, although doubtless of separate origin, are, for all practical purposes, identical. They are valued especially for earliness, although somewhat lacking in both size and productiveness, as compared with several later varieties.

Sweet Home is an old variety which seems not to have taken a hold upon popular favor, or to have developed specially valuable qualities. A limited experience with it here gives little promise of better results.

RED, YELLOW AND PURPLE VARIETIES.

Increasing by root-suckers; a few of which are also tip-rooting.

Brandywine, though by no means new, is still valued as one of the best red raspberries for marketing. Even when so overripe as to drop from the plant, it may yet be marketed in fair condition.

Caroline is an alleged hybrid between *R. Idæus* and *R. occidentalis*. It is very hardy, and roots from either suckers or tips, though somewhat reluctantly from either. The fruit is of scarcely medium size, pale yellow, of delicate texture, and produced very abundantly. The quality is only medium. Origin, New York.

Cuthbert still holds an unquestioned position, as one of the most desirable of the red varieties, whether for the home plat or for market. The plant is very vigorous, and resists mildew of the foliage unusually well.

Golden (Golden Queen) is clear bright yellow in color. Otherwise it is very much like Cuthbert, in both plant and fruit. For the home plat it is excellent.

Griesa (the name of the introducer, temporarily applied) is a red variety. The habit of the plant is intermediate between *R. strigosus* and *R. occidentalis*. Like Caroline, it roots, rather reluctantly, from both suckers and tips. The fruit possesses the general characteristics of *R. strigosus*. It requires further trial to determine the question of productiveness. It hails from Kansas.

Hansell is early, and the plant hardy. It is valued for planting, to a limited extent, for both home use and market, on account of its earliness.

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Marlboro, though rather low in quality, is large and bright colored. It is popular as a rather early market variety.

Muskingum is of comparatively recent introduction, coming, as we understand, from Ohio. The plant is exceedingly vigorous and very productive, with characteristics referable mainly to the species *strigosus*, while the fruit has the large size, dark color and general appearance of Shaffer. It equals Shaffer in productiveness and, like it, is excellent for canning.

Reder (although the plant may not be satisfactory for commercial uses) has few if any superiors in size; rich, bright color, fine texture and flavor, for the table. It is fairly productive. A native of Berrien county, Michigan.

Reliance, like its parent, the old and now abandoned Philadelphia, is very hardy and productive. The fruit is high flavored, but dark colored, and rather small. It is well adapted to localities in which great hardiness is requisite.

Shaffer is too widely known to require extended notice. The vigor and productiveness of the plant, with the high, rich flavor and large size of the fruit, especially adapt it for canning, for which purpose it has long been popular.

Thompson has, this season, proved highly productive. Should it continue thus, it may prove desirable as an early market variety.

Thwack, though only planted last year, was well tested here several years since. It is hardy, vigorous, of good size, and productive, although very low in quality. Although old, it has never become popular for either amateur or market purposes.

Turner is small and very mild in flavor. The plant is vigorous, and the canes destitute of spines. It is the hardiest of the red raspberries and (doubtless for that reason) is somewhat popular at the west and north.

Herstine, like all varieties of its species (*Idaeus*), tested in this country, lacks hardiness, requiring winter protection, even in the comparatively mild winter climate of southwestern Michigan. On account of its large size, bright color, and superior flavor, it is deemed worthy of the needful winter protection. Origin, Pennsylvania, from seed of a foreign variety.

BLACKBERRIES (*Rubus villosus*).

The entire loss of many plants, and the serious injury of others, resulting from the almost continuous drenching rains, during the late spring and early summer of 1892, were but partially remedied by the subsequent growth of that year, leaving the stand of plants decimated or uneven to such extent that comparisons of actual fruitage during this season will afford no just indication of the comparative productiveness of the varieties under ordinary conditions. Under such circumstances, therefore, resort is had to estimates, based upon the actual performance of such plants as appear to be most nearly in a normal condition, results being indicated upon a scale of one to ten.

Anthracnose having been very prevalent during the year 1892, attacking nearly or quite all the varieties of blackberries as well as of raspberries, the plat was included in the spraying which the plantation received, after the dropping of the foliage in late autumn, 1892. Early last spring

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examination was made, and all canes showing indications of anthracnose were cut out and burned.

On April 1 to 3 last, the plants received a spray of Bordeaux.

Again on April 24 and 25, they were sprayed with reduced Bordeaux, using 32 gallons of water and adding two ounces of Paris green.

A final spray was given on May 8 and 9, using two pounds of copper sulphate, with one and one-half pounds of lime in 22 gallons of water, and adding two ounces of Paris green.

As the apparent result of these several sprayings, with the removal of the previously diseased canes, scarcely a trace of fungus has at any time during the season appeared upon blackberries, while, in all cases, satisfactory growths have been made.

The leaf miner is apparently not amenable to spraying, having proved increasingly troublesome this season, confining its attacks almost wholly to the blackberry.

BLACKBERRIES—(*Rubus villosus*).

Number.	Name.	Origin.	Planted.	First bloom.	First ripe fruit.	Productiveness. Scale, 1 to 10.	Remarks.
1	Agawam	N. E.	1888	June 12.	July 27.	4	Usually large and fine.
2	Bonanza		1888	" 14.	" 27.	4	Name a misnomer.
3	Briton (Ancient Briton)	Eng.	1888	" 13.	" 28.	3	Usually over-productive.
4	Childs (Tree)		1892				Not yet tested.
5	Cluster (Early Cluster)	N. J.	1888	June 13.	July 25.	10	Of little value.
6	Eldorado	Ohio	1892				Not yet tested.
7	Erie	Pa.	1888	June 12.	Aug. 2.	5	Generally productive.
8	Fruitland	Ohio	1892				Good grower. Not fruited.
9	Harvest (Early Harvest)	N. J.	1888	June 13.	July 17.	5	Small. Very early.
10	Hoosac	Mass.	1891				Old. Thornless.
11	King (Early King)	N. J.	1890	June 14.	July 21.	10	Very desirable so far.
12	Kittatinny	N. J.	1888	" 14.	" 29.	6	One of the best; rather tender.
13	Knox		1888	" 15.	" 27.	5	Large. Bears thinly.
14	Lawton	N. Y.	1888	" 13.	" 27.	4	Old. Often winter-killed.
15	Lincoln		1891	" 12.			New. Not yet fruited here.
16	Mammoth (Early Mammoth)	Ohio	1891	" 14.	July 31.	4	Needs farther trial.
17	Minnewaska	N. Y.	1888	" 15.	Aug. 2.	4	Is generally more productive
18	Nevada		1888	" 15.	July 27.	3	Not valuable here.
19	Ohmer	Ohio	1892		" 29.	2	But partially tested.
20	Oregon (Everbearing)	Oregon	1892				Not yet fruited here.
21	Snyder		1888	June 10.	July 25.	10	Rather small. Very hardy.
22	Stone	Wis.	1890	" 10.	Aug. 5.	3	Small. Very hardy.
23	Taylor		1888	" 12.	July 29.	6	Hardy. Excellent.
24	Thompson (Early)	Ohio	1890	" 13.	" 28.	9	New. Promising.
25	Triumph (Western Triumph)		1888	" 14.	Aug. 1.	2	Small. Hardy. Vigorous.
26	Wachusett	Mass.	1890	" 10.	July 27.	5	Old. Thornless.
27	Wallace		1888	" 13.	" 29.	5	Large. Very good.
28	Wilson	N. J.	1888	" 13.	" 28.	6	Canes tender. Large. Early.
29	Wilson, Jr.	N. J.	1888	" 13.	" 25.	6	Is Wilson reproduced.

Notices are appended of some of the older varieties, with their performance during the current year, together with a few of the more recent introductions.

Agawam has been fruited here for several years. It has rarely, if ever, suffered injury from the lake shore winters. It is productive, and the fruit is large and excellent. It is eminently worthy of a place in the home plat.

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Briton (Ancient Briton) has been a long time in cultivation in this country, and is popular at the west, where the larger varieties fail from lack of hardiness. It has been assumed to be a native, but recent investigation determines that it was originally imported from England. Its comparatively small size renders it unpopular where larger though less hardy varieties can be profitably grown.

Erie is very vigorous, with many large, strong, prehensile spines, and is hardy in this climate, though it suffered seriously from the long wet spell of last year. The fruit is very large, and of fair quality, if allowed to fully ripen upon the plant. The habit is spreading, and the canes should be tied to a trellis or stakes, to prevent injury from high winds.

Harvest (Early Harvest) is a moderately vigorous, very upright grower and very productive. The fruit is rather small, of firm texture, ripening quite in advance of the usual blackberry season, and, for that reason, profitable. A spurious variety, of similar habit, has been disseminated under this name.

King (Early King), received from New Jersey, has fruited here this season only. The plant is vigorous and productive, and the fruit quite large and of good quality, ripening rather early.

Kittatinny has long been recognized as the best of the large varieties, though deficient in hardiness. For some years it has been more or less subject to attacks of the fungus known as red rust, which has, in many cases, proved a serious drawback upon the value of the variety, though it may be held in check, and even exterminated, by promptly digging and burning the diseased plants when discovered.

Lawton, though not the first blackberry subjected to cultivation, was the first one extensively disseminated for such purpose. It lacks hardiness and, as usually marketed, is objectionably acid, though, when thoroughly ripened upon the plant, it is large, sweet and delicious.

Mammoth (Early Mammoth), was received from a nursery formerly in Ohio (now in Virginia), and has only fruited here this season. It promises well. Fruit large, of good quality, and the plant is vigorous.

Minnewaski was received some years since from its originator, the late A. J. Caywood, of New York. The plant is a strong, rather erect grower; productive, and of fully medium hardiness. The fruit is large and of good quality.

Oregon (Everbearing) comes to us as an estray from the Pacific coast, as its name indicates. It has not yet fruited here, though it seems desirable, if only as a curiosity. The plant has the trailing habit of a dewberry with the usual reflexed spines of the blackberry. The foliage has the usual five leaflet arrangement of the blackberry, with each leaflet somewhat irregularly divided, lobed and serrated, somewhat after the manner of the cutleaved birch or maple.

Snyder is well known as a hardy and productive market variety; extensively planted in localities in which special hardiness is requisite.

Stone (Stone's Hardy) hails from Wisconsin. It is a spreading, vigorous grower and very hardy. Fruit too small to be acceptable where larger varieties are successful.

Taylor is nearly as hardy as Snyder, with more branching, light colored shoots. It is very productive, ripening its rather large, superior flavored fruit, somewhat after the average season.

Thompson (Early) comes to us from Ohio. It proves hardy here, and

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has this year excelled most other varieties in productiveness. The fruit is of fair size and good quality. (Probably Mammoth, L. R. T.)

Triumph (Western Triumph) is one of the varieties approved at the west on account of hardiness. The plant is tall, rather upright, branching; although the fruit is of less than medium size, the deficiency is more than compensated in productiveness. It must have good soil and culture to produce marketable fruit.

Wallace came to us from the west. The plant is vigorous and moderately productive. Fruit of large size and good quality. It is worthy of more attention than it has heretofore received.

Wilson, and Wilson, Jr., (the latter a seedling of the former) are for all practical purposes identical. Both have, to a slight extent, the spreading habit of the dewberry and, like it, will sometimes root, though reluctantly, from the tips. Both are deficient in hardiness. Fruit large to very small, and not of high quality.

SERVICE BERRY.—(*Amelanchier.*)

An indigenous form of this plant, forming a large bush or small tree, occasionally from twelve to fifteen feet in height, is more or less disseminated in Michigan forests. It varies greatly in productiveness, as well as in size and quality of fruit. As far as known, no attempts have been made to subject this to cultivation.

The dwarf variety, which was planted here as early as 1876, under the name Service Berry, only tends, if left undisturbed, to form dense clumps, by means of underground branches or stolons, under which conditions it becomes comparatively unproductive. When such tendency is prevented by occasional transplanting, or otherwise, the result is a very considerable improvement in size, as well as in quantity of fruit.

Birds have a special liking for the fruit, which ripens in succession, and invariably falls a prey to their rapacity, before full maturity.

The bushes rarely exceed three feet in height, and the fruit, which resembles the huckleberry, is by no means its equal in quality.

Three varieties are on trial here.

The first, lacking a varietal name, is designated as *common*. On a scale of one to ten, it ranks, this year, about eight in productiveness.

The second, received from Indiana as Mammoth, is slightly larger in plant, and in productiveness ranks nine.

The third is named "Success" by the recent chief of the Division of Pomology at Washington. In productiveness it will rank ten.

A few plants received a covering of netting, to protect the fruit from the birds. This was applied on July 7, when the fruit began to color. The fruit was gathered about July 18, fully ripe, and beautiful in appearance, though, from lack of rich flavor, it can scarcely supersede the better varieties of huckleberries, where such are obtainable.

CURRANTS.—(*Ribes.*)

The plantation of currants suffered more or less from the long continued drenching rains of the spring of 1892; although the most serious injury arose from the cutting away of a large portion of the bearing wood, in the effort to eradicate the twig borer (*Aegeria tipuliformis*, Linn.) which has long been extremely prevalent in this region.

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The currants were included in the spraying given the entire plantation, after the fall of the leaves in the autumn of 1892.

A spray with Bordeaux mixture was given them on April 1–3, 1893. They received a second spray on April 18, using 4 lbs. copper sulphate, 3 lbs. lime and 2 oz. Paris green, in 32 gals. water.

Rain having intervened, a reapplication of the same was given on April 24 to 25.

On May 8–9 another spray was given, using 3 lbs. copper sulphate, 1½ lbs. lime, and 2 oz. Paris green, in 32 gals. water.

The currant worm having put in an appearance, a spray of 2 oz. potassium sulphide (liver of sulphur), and one oz. Paris green, in ten gals. water, was applied on June 2.

This was repeated on June 21, using 3 oz. potassium sulphide instead of two. Rain having intervened, the same was reapplied June 24.

This preparation was again applied on July 6, omitting the Paris green; and yet again for the last time, on July 22.

These sprayings have, apparently, had the effect, not only to hold the currant worm in subjection, but also to prevent the attacks of the fungus, which has so generally ruined the foliage early in August, since, under this treatment (which was also applied to the gooseberry), there has been no loss of the foliage of either, down to the time of this writing (Oct. 1), while the plants generally have made satisfactory growth.

It may also be stated, as a possible result of these repeated sprayings, that few indications are visible of the attacks of the twig borer; the inference being, either that the liver of sulphur is repulsive to the moth or, otherwise that the Paris green may have proved fatal to the larvæ when making their first meal upon the recently sprayed twigs.

1. MISSOURI OR YELLOW FLOWERING CURRANT—(*Ribes aureum*).

Number.	Name.	Origin.	Planted.	First bloom.	First ripe fruit.	Productiveness. Scale 1 to 10.	Remarks.
1	Crandall	Kan.	1889	May 12	July 8	5	Of doubtful value.

2. BLACK, FETID CURRANTS—(*Ribes nigrum*).

Number.	Name.	Origin.	Planted.	First bloom.	First ripe fruit.	Productiveness. Scale 1 to 10.	Remarks.
1	Champion (Black Champion)	Europe	1889	May 12	July 11	7	Try further.
2	English (Black English)	"	1892	" 13	" 14	2	Needs further trial.
3	Lee	"	1888	" 12	" 8	4	One of the best blacks.
4	Naples (Black Naples)	"	1888	" 15	" 10	4	Old; well known.
5	Saunders	Ont.	1890	" 15	" 10	4	Yet too recent.
6	Wales (Prince of Wales)	"	1890	" 12	" 14	3	Yet too recent.

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3. RED AND WHITE CURRANTS—(*Ribes rubrum*).

Number.	Name.	Origin.	Planted.	First bloom.	First ripe fruit.	Productiveness, scale 1 to 10.	Remarks.
1	Cherry	Eur.	1888	May 12	July 14	0	One of the largest. Acid.
2	Fay	N. Y.	1888	" 10	" 11	1	Large. Plant unsatisfactory.
3	Holland (Long bunch'd Holland)	Eur.	1889	" 10	" 11	6	Strong, healthy. Late.
4	Lakewood	Ohio	1890	" 10	" 14	1	Need a fuller trial.
5	London (Red)	Eur.	1890	" 12	" 8	10	Best for culinary uses.
6	Moore Ruby	Am.	1890	" 10	" 8	6	Best red variety.
7	Moore Select	Mass.	1890	" 10		0	Requires further trial.
8	North Star	Minn.	1892	" 14	July 14	1	Very vigorous. Hardy.
9	Red Dutch	Eur.	1888	" 10	" 8	5	Most valuable red currant.
10	Raby Castle	"	1892			1	May prove to be Victoria, but said to be distinct.
11	Versaillaise	"	1888	May 12	July 10	0	Much like Cherry.
12	Victoria	"	1888	" 10	" 10	7	Seldom attacked by borers
13	White Dutch	"	1888	" 10	" 10	7	Finest flavored currant.
14	White Gondoin	"	1890	" 10	" 8	8	Needs further trial.
15	White Grape	"	1888	" 10	" 8	7	Most profitable white variety.
16	Wilder	Am.	1890	" 10	" 10	1	Promising.

Owing to the operations of the twig borers during the year 1892, and the amount of bearing wood unavoidably destroyed during the past spring, in the effort to exterminate them, the product of the season now past has been greatly diminished. For this reason the estimates of productiveness given in the foregoing tabulation indicate but imperfectly what would be the relative yield of the varieties named under more favorable conditions. For this reason short notices of some of the varieties are given, for the purpose of, at least in part, remedying such defect.

Crandall (when the heaviest fruiting plants *only* are considered) proves highly productive. The quality of the fruit, when well cooked, is good, but for the extreme thickness and toughness of the skin, even when thoroughly cooked—a difficulty which, apparently, could only be obviated by straining the cooked product.

Naples (Black Naples) and Lee are the only fetid black currants sufficiently tested here. How the remaining varieties upon the list will rank as to quality, size, productiveness, etc., can only be surely determined after a somewhat lengthened trial. From present indications, they differ but slightly in these respects.

White Dutch, White Gondoin and White Grape rank in about the order named, so far as rich, mild flavor and consequent adaptation as dessert varieties is concerned. In these particulars they are quite superior to any of the red varieties, with the possible exception of the Moore Ruby, which is yet but imperfectly tested.

Cherry, or its close rival Versaillaise, must be allowed to stand in advance of Fay so far as profitableness and adaptation for market are concerned. All are acid and large and, for that reason, popular in the market.

Red Dutch, although one of the oldest varieties, yet stands first among the red currants, so far as quality as well as productiveness is concerned. But for a slight lack of size, it would doubtless lead also in the market.

Victoria is scarcely as large, and a little later than Red Dutch. On

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account of its comparative exemption from the attacks of the twig borer, and the greater persistence of its foliage, it is popular for market planting in many localities.

Holland (Long Bunched Holland) is doubtless the most vigorous of red currants, and holds its very large foliage more persistently than any other of our acquaintance. It is productive and late, the cluster long, but the berry small.

London (London Red) is exceedingly productive; the berry medium; said to be superior for jams and jellies.

Lakewood, Moore Select and Wilder, though some time on trial, cannot yet be definitely characterized.

North Star was planted only last year. It shows unusual vigor, but its other qualities remain undetermined.

Raby Castle, planted in 1892, may prove to be Victoria, although Mr. J. H. Haynes of Delphi, Ind., from whom the plants were obtained, claims that it is a new variety, quite distinct from the old Raby Castle.

GOOSEBERRY (*Ribes*).

The plantation of gooseberries, being adjacent to that of currants, the two have been subjected to the same treatment, so far as spraying is concerned, for an account of which the reader is referred to the section on currants.

The result of such repeated spraying has been an entire absence of mildew, whether of foliage or fruit, save in the single case of the Smith, which, apparently from previous enfeeblement, has failed to fruit this year, and has also prematurely lost more or less of its foliage.

The use of a few ounces of Paris green in the potassium sulphide spray has kept the currant worm in subjection.

The crumpling of the young leaves at the tips of the branches (mainly of the Houghton), attributable, doubtless, to minute aphides, has been but slightly troublesome this year, it having been cut away and burned upon its appearance.

Nearly all varieties, whether of native or foreign parentage, have fruited very thinly, a result probably due to the enfeeblement consequent upon the excessive and long continued wet weather of early 1892, together with the mildew consequent thereupon, preventing, as it doubtless did, the development of the fruit buds necessary for the next season's crop.

1. WILD GOOSEBERRY—(*Ribes cynosbati*).

Number.	Name.	Origin.	Planted.	First bloom.	First ripe fruit.	Productiveness. Scale, 1 to 10.	Remarks.
1	Downing	N. Y.	1888	May 9	July 14	8	Valued for market.
2	Mountain	N. Y.	1888	" 17	" 17	0	Not desirable.
3	Smith	N. E.	1888	" 10		0	Poor grower. Fruit superior.
4	Strubler*	Ill.	1892				Strong grower.
5	Tree*	Ohio	1892				Strong grower.

* Nos. 4 and 5 have not yet fruited. Their correct classification is doubtful.

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1. EUROPEAN GOOSEBERRY—(*Ribes grossularia*).

Number.	Name.	Origin.	Planted.	First bloom.	First ripe fruit.	Productiveness. Scale, 1 to 10.	Remarks.
1	Auburn	N. Y.	1890	May 24	July 15	1	The correct name unknown.
2	Golden (Golden Prolific)	N. Y.	1890	" 15		0	Quite liable to mildew.
3	Industry	Eur.	1889	" 12	July 14	1	Mildews, unless sprayed.
4	Orange (Early Orange)	N. Y.	1890	" 12	" 15	0	Mildews, unless sprayed.
5	Pearl	Ont.	1890	" 9	" 17	8	Very promising.
6	Oregon (now named Apex)	Oregon	1892				Not yet fruited.
7	Triumph	N. J.	1891	May 10	July 19	0	Objectionable name.

3. SMOOTH GOOSEBERRY—(*Ribes hirtellum*).

Number.	Name.	Origin.	Planted.	First bloom.	First ripe fruit.	Productiveness. Scale, 1 to 10.	Remarks.
1	Champion	Ohio	1888	May 10	July 15	0	Strong; healthy; unproductive.
2	Houghton	N. E.	1888	" 12	" 17	5	Hardy; very productive.
3	Pale Red	Am.	1890	" 10	" 17	6	Nearly identical with Houghton

Downing is a strong grower, with stout, very thorny shoots. Fruit large, round, green when mature. Popular in the market.

Smith is not a vigorous plant; very thorny. Fruit large, greenish-yellow, oval; of superior quality.

Mountain is a strong grower and free from mildew. Fruit large, but variable in size; poor in quality. Worthless.

Auburn is of European type, a moderate grower; has not mildewed here. Fruit large, light red when mature. The true name is unknown.

Golden (Golden Prolific), Orange (Early Orange) and Pearl are American seedlings of the European type. Industry is an importation from England. They are all more or less liable to mildew here, requiring occasional spraying to maintain their health in this climate.

Triumph, received from New Jersey, and Oregon (now named Apex) from the Pacific coast, received but recently, are understood to be American seedlings, the former of the European and the latter of the Pacific coast type.

Champion, although vigorous and apparently mildew proof, is so unproductive and the fruit so small and poor as to render it practically worthless.

Houghton and Pale Red are much alike. Both are hardy, productive and mostly free from mildew. They will bear neglect better than most varieties. Fruit small.

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CHERRIES (*Prunus*).

Probably few, if any, species of fruit trees are as impatient of excessive moisture in the soil as are the cherries. In their case the injury from the copious and long continued rains of the spring and early summer of last year has proved more serious than was apparent during that season, since quite a number of trees have this season shown indications of injury obviously attributable to that cause.

A large number of varieties have bloomed and fruited this season, but most of them so sparsely that, on account of the depredations of birds in many cases it has been difficult to accurately determine the date of ripening.

The cherry plantations were included in the spraying given the entire plantation in November, 1892.

April 10 and 11 cherries were sprayed with diluted Bordeaux, using 4 pounds copper sulphate, 3 pounds lime and 2½ ounces Paris green, in 32 gallons of water.

On June 8 they received the second spray this season, using 4 pounds copper sulphate, 3 pounds lime and 2½ ounces of Paris green, in 32 gallons of water.

On June 27 they were treated with kerosene emulsion to extirpate the slug (*Eriocampa cerasi*).

On July 7 the pest having reappeared the trees were treated with the extract of tobacco stems, after which further treatment for this insect was not found necessary.

On July 14 and 15 cherries received a final treatment, consisting of 2 pounds copper sulphate, 1½ pounds lime and 2½ ounces Paris green, in 32 gallons water.

The slug (*Eriocampa cerasi*) has been much less troublesome this year than formerly, yielding readily to the sprays given as stated.

No other insects have proved troublesome upon the cherry, the curculio apparently confining operations to adjacent rows of plums and peaches.

No attacks of fungi have been noticed, except as the cause of premature loss of foliage by a few of the injured trees already mentioned.

Experience has shown that the Mazzard or sweet cherries (and to a slight extent the Dukes also) when grown rapidly, as under thorough cultivation they usually do in our Michigan soil and climate, are often seriously if not even fatally injured during subsequent severe winters, and when branched as high as is generally done they are liable to what is known as "bark-burst" during severe cold in winter, followed by death after a very few years of decrepitude and disease.

No remedy has yet been discovered for such conditions. Prevention is, so far as known, the sole alternative. This may be accomplished by giving only so much manure and cultivation while the tree is still young as shall produce only moderate, healthy growth and partially or wholly omitting cultivation thereafter; also branching them so low that the trunk and larger branches, in which, if at all, bursting is likely to occur, shall be well shaded from the influence of the mid-day sun, by the foliage.

Under such conditions trees of these species may be reasonably expected to reach mature age in sound condition, while under opposite conditions

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they would be in danger of perishing even when scarcely yet in full bearing.

In the following tabulation the arrangement of last year placing Heart and Bigarreau cherries together in one class and Dukes and Morellos in another is continued.

1. HEART AND BIGARREAU CHERRIES—(*Prunus avium*).

Number.	Name.	Class.	Origin.	Planted.	First bloom.	First ripe fruit.	Remarks.
1	Bigarreau (Yellow Spanish)	Big.	Eur.	1890	May 20	July 10	Type of the Bigarreau class.
2	Cleveland	Big.	Ohio	1890	" 18		Originated by the late Dr. Kirtland.
3	Downer	Heart	Mass.	1888	" 15	July 4	Profitable for market.
4	Eagle (Black Eagle)	Heart	Eng.	1888	" 18	" 7	Old. Excellent.
5	Elton	Big.	Eur.	1890	" 18		Yellow, with a red cheek.
6	Florence	Big.	Italy	1891			Has not yet fruited.
7	Knight (Knight's Early)	Heart	Eng.	1890	May 19		An excellent early cherry.
8	La Maurie (Early Lamaurie)	Heart	Eur.	1892			Not yet tested.
9	Mary (Kirtland's Mary)	Big.	Ohio	1890	May 19		A seedling of Dr. Kirtland.
10	Mezel	Big.	Eur.	1890	" 20		Large. Popular in Europe.
11	Napoleon	Big.	Eur.	1892	" 19		Very firm. Fine market cherry.
12	Ohio (Ohio Beauty)	Heart	Ohio	1890	" 19		A fine variety from Ohio.
13	Purity			1891			Yet untested.
14	Purple (Early Purple)	Heart	Eur.?	1891	May 22		The earliest of the older cherries.
15	Rockport	Big.	Ohio	1890	" 18		Popular.
16	Tartarian (Blk. Tartarian)	Heart	Eur.	1888	" 17		Large. Tree upright, vigorous.
17	Transparent (Coe's Transparent)	Heart	Conn.	1888	" 17		One of the most beautiful.
18	Windsor	Big.	Ont.	1890	" 18		New, late, promising.
19	Wood (Gov. Wood)	Heart	Ohio	1890	" 18		A popular market variety

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2. DUKES AND MORELLOS—(*Prunus cerasus*).

Number.	Name.	Class.	Origin.	Planted.	First bloom.	First ripe fruit.	Remarks.
1	Abbess (Olgnies)	Morello.	Europe.	1888	May 18	July 12	A slender grower. Late.
2	Angouleme	Duke?	"	1888	" 21		Vigorous. Promising.
3	Baender	Morello.	"	1892	" 20		Not yet fruited.
4	Bessarabian	"	"	1888	" 17	July 8	Imported by Prof. Budd. of Iowa.
5	Brusseler (Braune)	"	"	1888	" 20		Imported by Prof. Budd. of Iowa.
6	Carnation	Duke	"	1890	" 18		Needs further trial.
7	Choisy	"	"	1888	" 20	July 5	Beautiful. Excellent. Amateur.
8	Du Nord (Griotte du Nord)	Morello.	"	1888	" 22		Imported by Prof. Budd, of Iowa.
9	Dyehouse	"	Am.	1890	" 19		Very early. Slender. drooping.
10	Eugenie	Duke	France.	1888	" 6	July 6	Comparatively new. Promising.
11	Everbearing	Morello.	Am.	1892	" 22		Yet untested.
12	Frauendorfor (Weichsel)	"	Europe.	1888	" 18	July 8	Late, very acid.
13	Galopin	"		1892			Not bloomed or fruited.
14	Glass (George Glasakirche)	Duke?	Europe.	1888	May 22	July 1	As importation by Prof. Budd.
15	Hortense	"	France.	1888	" 16	" 6	One of the largest of the Dukes.
16	King (Amarelle)	Morello.	Europe.	1892			Only tested as to growth.
17	Late Duke	Duke		1890	May 20		Old, but little known.
18	Lithaner (Weichsel)	Morello.	Europe.	1892			Has not shown bloom or fruit.
19	Louis (Phillippe)	"	"	1888	May 15	July 5	Late. Good. Lacks productiveness.
20	Lutovka	"	"	1888	" 17		Promising.
21	Magnifique	Duke	"	1888	" 20	July 31	A fine late variety.
22	Mahaleb	Mahaleb	"	1892			Used only as a stock.
23	May Duke	Duke	"	1888	May 18	July 6	The type of the class.
24	Minnesota (Ostheim)	Morello.	Am.	1892	" 19	" 10	Requires further trial.
25	Montmorency	"	Europe.	1888	" 20	" 5	Probably Mont. Ordinaire.
26	Montmorency (Large)	"	"	1890	" 19		Fruit destroyed by birds.
27	Montmorency (Ordinaire)	"	"	1890	" 22		Fruit destroyed by birds.
28	Montreuil	Duke	"	1890	" 20		Very promising.
29	Olivet	"		1892	" 20		But partially tested.
30	Ostheim	Morello.	Europe.	1888	" 18		Requires longer trial.
31	Ostheimer	"	"	1892	" 24		Not yet fruited.
32	Richmond (Ey. Richmond)	"	"	1888	" 22	July 1	Most popular for market.
33	Royal Duke	Duke	"	1890	" 20		Old, but little known.
34	Skianka	Morello.	"	1888	" 20	July 4	Imported by Prof. Budd.
35	Spate (Amarelle)	"	"	1888	" 22		Imported by Prof. Budd.
36	Strauss (Weichsel)	"	"	1888	" 18		Imported by Prof. Budd.
37	Suda	"		1892	" 22		Not yet well tested.
38	Twenty-five (Orel)	"	Europe.	1892	" 22		Not yet well tested.
39	Twenty-seven (Orel)	"	"	1892			Not yet well tested.
40	Weir 2	"	Ill.	1892	May 22		Not yet well tested.
41	Wragg	"	Iowa	1891	" 27		A slender grower. Late. Acid.

SWEET CHERRIES.

Purple (Early Purple), nearly black when fully ripe, is the earliest well tested cherry, of fair size and good quality, with the possible exception of La Maurie (Early Lamaurie), which has not yet fruited here.

Knight (Knight's Early), Eagle (Black Eagle), superior in quality, and Tartarian (Black Tartarian), valued for market, are among the most popular dark colored cherries.

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Of light colored varieties, Transparent (Coe) is excellent and very beautiful, while Cleveland, Elton, Wood (Gov. Wood), Napoleon and Rockport are firm, good handlers and, for that reason, adapted to marketing.

Bigarreau (Yellow Spanish) is the best of the light colored, firm fleshed varieties, but, unfortunately, it is liable to crack and decay before ripening, during warm, wet weather.

Downer, though less firm, is hardy, rather late, very productive, large, of rich color, profitable.

Windsor is newly introduced; said to ripen quite late. It is highly commended by those who have fruited it.

THE DUKES.

Intermediate between the sweet cherries and the Morellos, so far as vigor of growth and acidity of fruit are concerned.

Choisy (Belle de Choisy) is exceedingly beautiful and of mild flavor, and, in the opinion of many, unexcelled in any class. Unfortunately it lacks productiveness.

Eugenie, Hortense (one of the largest Dukes), Magnifique (very late), May Duke (the type of the class), Olivet and Montreuil (comparatively new varieties), are all worthy of greater attention than they generally receive.

Royal Duke and Late Duke are old varieties though, so far as known, not yet thoroughly tested in this State.

MORELLOS.

There appear to be several more or less distinct races which, among Europeans, appear to have been sub-classified accordingly. In this country, so far, such sub-classification has not received attention.

Dyehouse is a very spreading and even drooping grower and, so far, has been the first to ripen.

Richmond (Early Richmond) is so well known as a popular market variety that extended notice seems unnecessary. In season, it closely follows the foregoing.

Louis (Phillippe) is large, late and excellent for culinary purposes, but is slightly lacking in productiveness.

Wragg is valued at the west for its hardiness. It is late, nearly black, and quite acid. The tree is a slender, spreading grower.

Montmorency (see table) is probably identical with Montmorency Ordinaire.

Of the remaining varieties of Morello, a considerable number have now fruited; several of them, apparently, are quite late. Further trial is needful to determine their comparative values.

MULBERRIES (*Morus*).

This, in one or more species, occurs, though rarely, in the forests of this State, occasionally as a tree of considerable size.

The varieties grown at this station, however, are imported, being of such as have become improved, and taken on the habit of maturing their fruits in succession, through a considerable period.

Downing is an American seedling of this character from Multicaulis

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(*M. alba*). In severe winters it is occasionally injured, even in southern Michigan.

New American and Hicks also have this habit, with apparently superior hardiness.

Russian (*M. Siberica* of nursery catalogues) is abundantly hardy here, though of no value so far as fruit is concerned.

Teas Weeping, when grafted high on upright growing stocks, makes a beautiful lawn tree. The foliage is glossy and beautiful, much superior to that of Kilmarnock willow; long popular as a weeping lawn tree.

PEACHES (*Prunus Persica, Amygdalus Persica,* or *Persica Vulgaris* of various botanists).

The trees of this species upon the station grounds received a spray of Bordeaux of the usual strength after the leaves had fallen last autumn.

April 10 and 11, 1893, they were again sprayed, using 4 lbs. of copper sulphate, 3 lbs of lime and 2½ oz. of Paris green in 32 gallons of water.

June 8–12, the spray was repeated, using the same mixture.

June 29 they were again sprayed, using modified Eau Celeste. (Two lbs. of copper sulphate, 1½ lbs. of carbonate of soda and 1 qt. of ammonia water in 32 gallons of water.)

July 14 to 15 a final spray was given, using 2 lbs. copper sulphate, 1½ lbs. lime and 2½ oz. Paris green in 32 gallons water.

This last spray caused considerable loss of the older foliage, leaving that near the extremities of the young shoots in all cases apparently unaffected.

As the apparent result of the first two sprayings mentioned there has been an almost total absence of "leaf curl" (*Taphrina deformans*) which is usually quite prevalent here in early spring and which was present this year in neighboring orchards, causing many of the leaves and fruits to drop.

Apparently also the fungus which usually, in this climate, attacks the foliage and growing twigs of the serrate varieties of the peach has been subdued by these applications, since a single serrate variety growing here which has been annually very severely attacked by this fungus has this season almost wholly escaped, making sound healthy growth as in the case of other varieties.

The only insects which have proved troublesome are the curculio, for whose attacks jarring has been the remedy employed, and the borer (*Sannina exitiosa*) to remove which the trees were "wormed" in September —a process intended to be repeated in April or May next.

For more convenient reference all abbreviations are inserted at the head of the columns in which they are used.

In very many cases the *origin* of a variety is unknown or uncertain, for which reason in most cases the source from which the variety was received is inserted instead of the place of origin.

The word "cling" is appended to the names of varieties of that class, and in a few cases only the word "free" is appended to the name to avoid uncertainty. In all other cases the word "free" is to be understood, the column usually devoted to this particular being omitted as unnecessary.

In many cases names are simplified or objectionable portions enclosed in parentheses to indicate probable future elisions in compliance with the rules of modern nomenclature.

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PEACHES.

Number.	Name.	Origin.	Planted.	Flowers. l, large; s, small.	Glands. s, serrate; g, globose; r, reniform.	First bloom.	First ripe fruit.	Color. w, white; y, yellow; r, red.	Flesh. p, pale; y, yellow.	Flavor. s, sweet; v, vinous; a, acid.	Remarks.
1	Adrian	Mo.	1892	----	g						
2	Alexander	Ill.	1892	----	g	----------	----------	w r	p	v	A partial cling.
3	Allen	Mo.	1891	s	r	May 22					
4	Alpha	Mo.	1891	----	r						
5	Amelia	Mo.	1890	l	r	" 22	----------	----	----	----	Of Carolina.
6	Amsden	Mich.	1891	l	g	" 22	----------	w r	p	v	A partial cling.
7	Andrews (Mammoth)	Mo.	1892	----	r						
8	Barber	Mich.	1892	----	r						
9	Barnard	Mich.	1888	s	r	" 22	Sept. 11	y r	y	s	For market only.
10	Beers (Smock)	Mo.	1890	s	r	" 22					
11	Belle	Mich.	1891	----	g						
12	Bell (Favorite)	Del.	1890	s	r	" 24	----------	----	----	----	Distinct from Belle.
13	Bequette Cling	Tex.	1890	s	r	" 22					
14	Bequette Free	Tex.	1890	s	r	" 22					
15.	Bickell (Late)	Del.	1890	s	r	" 22	Oct. 30	w r	p	a	May not ripen here.
16	Bishop (Early)	Mo.	1891	s	g	" 22					
17	Bonanza	Mo.	1891	s	r	" 22					
18	Boyles	Mo.	1891	s	g	" 22	Sept. 20	----	----	----	Only a specimen or two.
19	Brandywine	N. J.	1890	s	g	" 22					
20	Brett (Mrs. Brett)	Mo.	1890	s	r	" 22					
21	Brigdon	N. Y.	1890	l	g	" 22	Sept. 20	y r	y	v	Valued for market.
22	Briggs (Gov. Briggs)	Tex.	1890	s	g	" 24					
23	Bronson	Mich.	1891	s	r	" 22					
24	Brown (Early)	Mich.	1892	l	r	" 22					
25	Burke	Mich.	1892	----	r						
26	Canada (Early Canada)	Mich.	1892	l	g	" 22					
27	Carolina (Beauty)	Mich.	1892								
28	Chair (Choice)	Ohio	1890	s	r	" 22					
29	Champion (Mich.)	Mich.	1890	l	s	" 26					
30	Champion (Ohio)	Ohio	1892	s	g	" 24					
31	Chili (Hill's Chili)	Mich.	1888	l	r	" 22	Oct. 5	y r	y	s	Comes true from the pit.
32	Chili (Seedling 2)	Mich.	1888	l	r	" 22	" 7	y r	y	s v	Seedling by C. Engle.
33	Chili (Seedling 3)	Mich.	1888	----	r	----------	" 7	y r	y	s v	Seedling by C. Engle.
34	Cleffey (Allen)	Mich.	1892	s	r						
35	Collister (McCollister)	Mo.	1891	s	r	May 24					
36	Columbia	Mo.	1891	l	r	" 22					
37	Conkling	Mo.	1890	l	r	" 22					
38	Coolidge	Mich.	1892	s	g	" 26	----------	w r	p	v	Old and valued.
39	Corner	Mich.	1891	s	r	" 22	Oct. 5	----	----	----	An Allegan Co. seedling.
40	Crawford (Early)	Mich.	1888	s	g	" 22	Sept. 7	y r	y	v	Fruit buds not hardy.
41	Crawford (Seedling 1)	Mich.	1888	s	g	" 22	" 10	y r	y	v	Seedling by C. Engle.
42	Crawford (Seedling 2)	Mich.	1888	s	g	" 22	" 14	y r	y	v	Seedling by C. Engle.
43	Crosby	Mass.	1892	s	r	" 29					
44	Crothers	Tex.	1891	s	g	" 22	Oct. 9	----	----	----	Quality good here.
45	Cuba (Dwarf Cuba)	Mich.	1892	----	r						
46	Dennis	Mich.	1891	l	g	" 22					
47	Diamond	Ohio	1892	s	g	" 27					
48	Druid Hill	N. Y.	1891	s	g	" 22					
49	Dunlap	Mich.	1892	s	r	" 29					
50	Early York (Large)	Mich.	1892	s	g	----------	----------	w r	p	s v	Old, popular, market.
51	Ede (Capt. Ede)	Mich.	1890	s	r	May 22					
52	Elberta	Tex.	1890	s	r	" 22					
53	Eldred Cling	Mo.	1891	l	g	" 20	Aug. 30				
54	Ellison	Ohio	1889	s	r	" 23	Oct. 9	y r	y	s v	A promising market variety.
55	Engle (Mammoth)	Mich.	1891	s	g	" 22	Sept. 20	y r	y	v	Promising for market.
56	Foster	Mich.	1888	s	g	" 22	" 9	y r	y	v	Large and showy.
57	Fox	Mo.	1891	s	g	" 22	Oct. 9				

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PEACHES—CONTINUED.

Number.	Name.	Origin.	Planted.	Flowers. l, large; s, small.	Glands. s, serrate; g, globose; r, reniform.	First bloom.	First ripe fruit.	Color. w, white; y, yellow; r, red.	Flesh. p, pale; y, yellow.	Flavor. s, sweet; v, vinous; a, acid.	Remarks.
58	Future Great	Mo.	1891	....	g						
59	Garfield	Mich.	1892	....	g						
60	Gem Cling	Tex.	1890	s	r	May 22					
61	George IV. (George the Fourth)	N. Y.	1888	s	g	" 22	Sept. 6	w r	p	s v	An amateur variety.
62	Globe	N. J.	1888	s	g	" 22	" 29	w r	p	v	Unproductive so far.
63	Gold Drop (Golden Drop)	Mich.	1890	l	r	" 22	.....	y	y	s	Probably an old variety.
64	Good	N. J.	1890	s	g	" 22					
65	Grant (Gen. Grant)	Mo.	1892	....	r	" 26					
66	Great Western	Mo.	1892	....	r						
67	Gudgeon (Late)	Mo.	1891	s	r	" 22	Oct. 17	w r	p	v	Late, promising.
68	Hale	Mich.	1888	l	g	" 22	Aug. 14	w r	p	v	Best and latest of the half clings.
69	Hale Oblong	Mich.	1888	l	g	" 22	" 18	w r	p	v	Seedling of C. Engle.
70	Hale Round	Mich.	1888	l	g	" 22	" 18	w r	p	v	Seedling of C. Engle.
71	Hance Golden	N. J.	1890	s	g	" 22					
72	Hance Smock	Del.	1890	s	r	" 22	Oct. 16	w r	p	v	Only one or two specimens.
73	Haas (John Haas)	Del.	1890	l	r	" 22	Aug. 30	w r	p	v	Promising.
74	Heath Cling	Del.	1890	s	g	" 22					
75	Hinman	Mo.	1891	l	r	" 22					
76	H. No. 34	N. Y.	1890								
77	Hold On (Geary's)	Mo.	1890	s	r	" 22	Oct. 12				
78	Hughes (1XL)	Mo.	1892	....	r						
79	Husted	Mich.	1891	l	r	" 22	Sept. 4	w r	p	v	
80	Hyatt	N. J.	1888	l	g	" 22	Aug. 23	w r	p	v	Finer than Hale.
81	Infant (Wonder)	Mo.	1892	s	g	" 24					
82	Ingold (Lady Ingold)	Mo.	1892	....	g	" 22					
83	Jacques	Mo.	1892	s	r	" 24					
84	Jacques Late	Mo.	1892	s	g	" 22					
85	Jones	Mo.	1882	s	g	" 24					
86	June Rose	Tex.	1890	l	g	" 22	Sept. 16	w r	p	s v	Promising.
87	Kalamazoo	Mich.	1890	s	r	" 22	Oct. 2	y	y	s v	Profitable for market
88	Kaloola	N. J.	1892	....	g	" 22					
89	Kevitt Cling (McKevitt Cling	Mo.	1892	....	g	" 22					
90	Late Barnard	Mich.	1892	s	r	" 22					
91	Late Snow (Snow's Late)	Ohio	1890	s	r	" 22	Sept. 20	y r	y	s	Promising.
92	Late White	Mich.	1888	s	r	" 22	Oct. 7	w r	p	v	Seedling of C. Engle.
93	Lemon Cling	N. J.	1888	s	g	" 22	Sept. 25	y r	y	s v	An excellent cling.
94	Lewis	Mich.	1891	l	r	" 22	" 8				
95	Lock Cling	Mo.	1892	s	r	" 22					
96	Louise (Early Louise)	Mich.	1891	l	r	" 22					
97	Love All	Mo.	1892	s	g	" 24					
98	Lovett (White)	N. J.	1890	s	r	" 22					
99	Magdala	N. Y.	1890	s	r	" 22					
100	Mammoth Heath	Mo.	1892	l	r	" 22					
101	Marshall (Marshall's Late)	Ohio	1890	s	r	" 24					
102	Marshal Neil	Mo.	1892	l	r	" 22					
103	Milhizer	Mo.	1892	s	g	" 24					
104	Minnie	Tex.	1890	s	r	" 22					
105	Missouri (Blood Leaf)	Mo.	1892	....	r						
106	Moore (Moore's Fav.)	N. J.	1890	s	g	" 22	" 18	w r	p	v	Promising.
107	Morris County (Rareripe)	Del.	1890	s	r	" 22	Oct. 20				
108	Morris White	Mich.	1888	s	r	" 22	Sept. 29	w	p	v	Valued for canning.
109	Mountain Rose	Mich.	1888	s	g	" 22	" 4	w r	p	s v	Profitable.
110	Muir	N. J.	1890	s	r	" 24					
111	Murat	Mich.	1889								
112	Mystery (Yellow Mystery)	N. J.	1888	s	r	" 22	" 14	y r	y	v	Beautiful and good.
113	N. Amer. Apricot	Mo.	1892	....	r						

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PEACHES—CONTINUED.

Number.	Name.	Origin.	Planted.	Flowers. l, large; s, small.	Glands. s, serrate; g, globose; r, reniform.	First bloom.	First ripe fruit.	Color. w, white; y, yellow; r, red.	Flesh. p, pale; y, yellow.	Flavor. s, sweet; v, vinous; a, acid.	Remarks.
114	Nectarine	N. Y.	1889	l	r	May 22	Oct. 7	w r	p	v	Beautiful, English.
115	Need (Need's Barnard)	Mo.	1892	s	r	" 22					
116	No. 34 H.	N. Y.	1890	l	r	" 22	Sept. 18	y	y	s	A yellow market peach.
117	Normand (Choice)	Mich.	1892		r						
118	Oldmixon Cling	Mich.	1888	s	g	" 22	Oct. 14	w r	p	v	Popular for a cling.
119	Ostrander (Early)	Mich.	1892		g						
120	Palmerston (Lord Palmerston)	N. Y.	1890	l	g	" 22					
121	Pansy	Tex.	1890	s	r	" 22					
122	Pearl	Mich.	1889		g	" 22	Sept. 25	w r	p	v	Seedling by C. Engle.
123	Picket (Late)	Mo.	1890	s	r	" 22	Oct. 18				
124	Pratt	N. Y.	1890	s	r	" 22	Sept. 13	y r	y	v	Promising.
125	Prince (Prince's Rareripe)	Del.	1890	s	g	" 22					
126	Princess (of Wales)	N. Y.	1889	l	g	" 22					
127	Prize	Mo.	1892		g						
128	Prize 1	Del.	1890	s	g	" 22					
129	Reed (Golden)	N. J.	1890	s	g	" 24					
130	Reeves (Favorite)	Mo.	1890	s	g	" 22					
131	Ringold	Tex.	1890		r						
132	River Bank	Mo.	1892	l	g	" 22					
133	Rivers (Early Rivers)	N. Y.	1888	l	r	" 22	Aug. 14	w r	p	v	Excellent for home use.
134	Rivers York (Riv. Ey. Yk.)	N. Y.	1890	l	g						
135	Roser	Mo.	1892	l	r	" 22					
136	Roseville Cling	Mo.	1892	l	g	" 22					
137	R. S. Stevens	N. Y.	1891	s	r	" 23					
138	Saint John	Del.	1890	s	r	" 22	Sept. 11	y r	y	s	Has many names.
139	Salway	Mo.	1890	s	r	" 22	Oct. 30	w r	p	v	Best very late.
140	Scott (Nonpareil)	Ohio	1890	s	g	" 20					
141	Sener	N. J.	1888	s	r	" 22					
142	Shipley	Mo.	1892	s	g	" 22					
143	Shipley Late	N. J.	1890	l	r	" 22					
144	Silver (Early Silver)	N. Y.	1888	l	r	" 22	Sept. 10				Pure white to the pit.
145	Smock Free	Mich.	1888	s	r	" 20	Oct. 27	y r	y	v	A standard late peach.
146	Smock X	Mo.	1892		r						
147	Southern Early	N. J.	1890	s	r	" 22					
148	Stark Heath	Mo.	1892	s	r	" 22					
149	Steadly	Mo.	1888	s	r	" 22	" 10				So far unproductive.
150	Stevens' Late	Del.	1890	s	r	" 22	" 17				Of doubtful value here.
151	Stevens' Rareripe	Del.	1890	s	r	" 22					
152	Strong (Mammoth)	Mo.	1892	s	g	" 22					
153	Stump (the World)	Mo.	1890	s	g	" 23					
154	Superb Cling	Mo.	1892		r						
155	Surpasse (Melocoton)	N. Y.	1890	s	r	" 23					
156	Surprise (Hynes)	Tex.	1890	l	g	" 22	Aug. 28	w r	p	v	Promising.
157	Switzerland	Mich.	1891	s	g	" 22					
158	Toquin	Mich.	1892	l	r	" 22	Sept. 19	y	y	s v	A market variety.
159	Townsend	Mo.	1892	s	g	" 22					
160	Troth (Early)	Mich.	1888	s	g	" 22					A market variety.
161	Tuscany (Hardy Tuscany)	Mo.	1892		r						
162	Wager	Del.	1890	l	r	" 22	Oct. 7				Variety incorrect.
163	Walker	Mo.	1892	s	g	" 22					
164	Walker Variegated	Mo.	1890	s	g	" 22					
165	Waterloo	N. Y.	1888	l	r	" 22	Aug. 4	w r	p	v	Very early, promising.
166	Wheatland	N. Y.	1888	s	g	" 22	Sept. 18	w r	p	v	Desirable if productive.
167	Williamson (Choice)	Mich.	1892	s	g	" 22					
168	Worthen (Jennie Worthen)	Tex.	1890	s	r	" 22	" 20	y r	y	s	Promising.
169	Wonderful	Mich.	1890	s	r	" 23	Oct. 24	y r	y	v	Of uncertain value.
170	Yellow Rareripe	Mich.	1888	s	g	" 22	Sept. 13	y r	y	v	Several varieties so named.

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NECTARINES.

Botanists class these with peaches, the chief difference being in their smooth skins.

Number.	Name.	Origin.	Planted.	Flowers. l, large; s, small.	Glands. s, serrate; g, globose; r, reniform.	First bloom.	First ripe fruit.	Color. w, white; y, yellow; r, red.	Flesh. p, pale; y, yellow.	Flavor. s, sweet; v, vinous; a, acid.	Remarks.
1	Pitmaston (Orange)	Mich.	1892		r						
2	Unnamed seedling	Mich.	1888	s	r	May 22	Sept. 12	w r	p	v	May prove desirable.

Very many of these tabulated varieties are but imperfectly tested here and are included to afford at least a partial means of identification through the flowers and leaf glands.

Short notices are given of the more desirable varieties whether for market or domestic purposes.

Barnard, Chili (Hill's Chili), Gold Drop, Gudgeon (Late), Hale, Kalamazoo, Mountain Rose, Stump (the World), and Salway (very late) are each and all more or less popular as market varieties.

In addition to these, Crawford (Early and Late), Foster, Oldmixon Free, and Smock Free are only less valued for such purpose on account of greater liability to the winter-killing of the fruit buds.

The delicate texture of many varieties to some extent unfits them to endure the rough treatment to which commercial varieties are usually subjected, while for this peculiarity they become the more desirable for home uses. Among such are the Crawfords (Early and Late), Foster, George IV, Hale, Rivers (Early), Surprise (Hynes), and Waterloo.

The very early varieties, Alexander, Amsden, Waterloo, and others, which with their typical parent, the Hale, are known as semi-clings, are quite inclined to rot before ripening. Still, if planted in an airy location, a few may prove desirable, at least in the home plantation.

Surprise (Hynes) obviously is one of this class, coming from Texas. A longer trial is needful to determine its value here.

Brigdon comes from central New York where it is deemed valuable for the market. It first fruited here this season.

Two seedlings of Chili (Hill's Chili), by C. Engle of Paw Paw, which have produced fine crops here this season are slightly later than the parent, more highly colored and of finer flavor.

The same is true of two Crawford (Early) seedlings from the same source, at least one of which promises well as a market variety.

Engle (Mammoth), also from the same, has already acquired some reputation as a market variety.

Hyatt and two Hale seedlings by Engle have produced fine, large crops of fruit; a little earlier, larger, more highly colored and less "clingy" than Hale. They give indications of value for both amateur and market purposes.

Morris White and Silver (Early Silver) are heavy bearers with clear

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white flesh, not colored at the pit, and for that reason especially desirable for canning or preserving.

Ellison has borne a fine crop; fruit yellow, a good handler, and promising for the market.

Toquin, originating in the town of that name, and also a variety received for trial from New York with the cabalistic cognomen, "No. 34 H." have borne a few specimens each giving indications of adaptation to the market.

Wonderful, with a name apparently devised to promote sales, has borne a few specimens which prove wonderful, if at all, from their failure to justify the name.

A very considerable number of others have shown more or less fruit, but in most cases not sufficient to warrant an opinion as to their probable value.

GRAPES (*Vitis*).

With the exception of the very severe drouth of the past summer and early autumn, the season has been favorable for the grape.

The Rose chafer (*Macrodactylus subspinosus*), although very numerous on a number of plum trees on light soil, has, this season, been very rare upon the grape. A few grape vine flea beetles, (*Graptodera chalybea*), have been found, but not in considerable numbers.

Of fungi, powdery mildew and anthracnose, (*Spaceloma ampelinum*), have been somewhat troublesome, although almost wholly confined to varieties hybridized with *V. vinifera.*

The grapes, in common with the entire plantation, received a spray of Bordeaux mixture, of the usual strength, after pruning in the autumn of 1892, for the destruction of the resting spores of fungi.

Prior to the commencement of operations for the current year, plants were reserved as the basis of a set of experiments in the use of a variety of mixtures as preventives or remedies for fungi, as follows:

Of Moore Early, Salem, Ulster and Wyoming, five sets, of two plants each.

Of Brighton, six sets, of three plants each.

Of Concord and Niagara, six sets, of two plants each.

Of each variety, the first set was left unsprayed, as a means of comparison.

The second set of each of the four first named varieties was sprayed four times, on April 15, May 25, June 20 and July 10, with ½ lb. copper sulphate, 1 lb. carbonate of ammonia in 32 gallons water.

The third set of the same received four sprayings on or near the same dates, with ammoniated copper carbonate in 32 gallons water.

The fourth set was sprayed at above dates, with modified Eau Celeste.

The fifth received a spray at same four dates with 1 lb. copper sulphate, ¾ lb. stone lime in 50 gallons water.

Upon examination made at the close of the growing season, upon the scale of 1 to 10:

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Moore (Early)	No.	1	ranked	1	Wyoming	No.	1	ranked	2
"	"	2	"	3	"	"	2	"	1
"	"	3	"	4	"	"	3	"	3
"	"	4	"	4	"	"	4	"	1
"	"	5	"	2	"	"	5	"	1
Ulster	"	1	"	3	Salem	"	1	"	1
"	"	2	"	5	"	"	2	"	2
"	"	3	"	3	"	"	3	"	2
"	"	4	"	3	"	"	4	"	1
"	"	5	"	3	"	"	5	"	2

Of Brighton, Concord and Niagara, also, the first sets were not sprayed.

The second sets were sprayed but once, and that before growth commenced.

The third sets were sprayed once only, and that soon after blooming.

The fourth sets were sprayed on April 14, and again on June 15, using 4 lbs. copper sulphate, 3 lbs. stone lime, in 22 gallons water.

The fifth sets received three sprayings of the same on April 14, June 1 and July 1.

The sixth sets were sprayed four times with the same on April 14, May 27, June 20 and July 10.

Brighton	"	1	"	6	Niagara	"	1	"	2
"	"	2	"	5	"	"	2	"	2
"	"	3	"	4	"	"	3	"	1
"	"	4	"	3	"	"	4	"	2
"	"	5	"	2	"	"	5	"	4
"	"	6	"	1	"	"	6	"	2
Concord	"	1	"	2					
"	"	2	"	1					
"	"	3	"	1					
"	"	4	"	1					
"	"	5	"	1					
"	"	6	"	1					

In all these cases the defects were mainly in foliage rather than fruit.

The annual pruning of grapes having been completed, and the cuttings and fallen foliage removed and burned, on November 9 and 10, a thorough spray was given them for the purpose of destroying the spores of fungi.

It is clearly true that, in the interest of pomological accuracy as well as brevity, the use of numbers, whether in connection with names of fruits or otherwise, should never have been tolerated, and should be discouraged and abandoned, notwithstanding the fact that very many otherwise critical and careful pomologists still indulge in their use. In the interest of reform therefore, in this report, numbers attached to names are omitted, save in the case of trial varieties not yet offered to the public, and which have not yet established their right to receive a name.

Short notices are appended of several desirable, well known varieties, also of others, less generally known, and of yet others, comparatively new or yet unintroduced.

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GRAPES.

Number.	Name.	Origin.	Planted.	Bunch. (1, large; m, medium; s, small.) Size.	Bunch. (1, long; m, medium; s, short; sh, shouldered.) Form.	Berry. (1, large; m, medium; s, small.) Size.	Berry. (r, round; o, oval.) Form.	First bloom.	Ripe.	Quality, 1 to 10.	Product, 1 to 10.	Remarks.
1	Adirondac	N. Y.	1890	l	l sh	l	r	June 24	Sep. 10-17	8	8	Plant of uncertain identity.
2	Agawam	Mass.	1888	l	l sh	l	r	" 24	" 17-24	7	8	A long keeper.
3	Aminia	Mass.	1888	m	sh	m	r	" 26	" 17-24	8	9	A Rogers' hybrid.
4	August Giant	N. Y.	1889	l	sh	l	o	" 26	" 24-Oct. 1	5	4	Identity doubtful.
5	Barry	Mass.	1888	l	sh	l	r	" 24	Sep. 17-24	8	7	Inclined to mildew.
6	Beagle	Texas	1889	m	sh	m	r	" 24	Oct. 5-10	6	7	Of medium quality.
7	Bell	Texas	1889	s	s	m	r	" 26	Sep. 17-24	4	..	Trial imperfect.
8	Belvidere	Ill.	1890	l	sh	m	r	.....	.....	8	9	Very early.
9	Berckmans	S. C.	1891	....	.....	....	.....	.....	.....	..	..	Not yet fruited here.
10	Black Eagle	N. Y.	1890	l	m sh	l	r	June 27	Sep. 10-17	8	9	A wine grape here.
11	Black Pearl	Ohio	1890	....	.....	s	r	" 29	Oct. 3-10	..	..	Only a wine grape.
12	Blanco	Texas	1889	s	.....	s	r	" 24	.....	..	..	Needs further trial.
13	Brighton	N. Y.	1888	l	l sh	l	r	" 27	Sep. 17-24	10	7	Requires cross fertilization.
14	Brilliant	Texas	1889	s	s	l	r	" 28	" 17-24	3	..	Mildews badly.
15	Burnett	Ont.	1891	l	m sh	l	o	.....	.....	..	..	Try further.
16	Cambridge	Mass.	1890	l	sh	l	o	June 24	Sep. 10-17	6	8	
17	Campbell	Texas	1889	....	.....	m	r	" 22	" 10-17	5	..	Imperfectly tested.
18	Catawba	S. C.?	1888	l	sh	m	r	" 27	Oct. 1-8	7	8	Scarcely ripens here.
19	Cayuga	N. Y.	1889	s	.....	s	r	.....	.....	..	8	Needs a longer trial.
20	Caywood 50	N. Y.	1888	m	.....	l	r	June 21	Sep. 10-17	6	9	Promising for market.
21	Centennial	N. Y.	1890	m	m sh	m	r	" 22	" 17-24	9	10	Foliage not healthy.
22	Challenge	N. J.	1890	s	sh	m	r	" 21	" 17-24	6	8	Very early.
23	Champion	N. Y.	1889	l	sh	m	r	" 24	Aug. 27-Sep. 2	3	8	Almost worthless.
24	Chidester 1	Mich.	1888	m	sh	m	r	" 26	Sep. 10-17	9	3	Good, but unprofitable.
25	Chidester 2	Mich.	1888	m	sh	m	r	" 27	" 17-24	6	8	Promising for market.
26	Chidester 3	Mich.	1892	....	.....	....	.....	" 26	" 10-17	..	..	First fruited.
27	Chidester 4	Mich.	1892	....	.....	l	o	" 26	" 27-Oct. 2	8	..	Imperfectly tested.
28	Clark	Div Pom	1892	....	.....	....	.....	.....	.....	..	..	Cuttings from Div. of Pomology.
29	Clevener	N. Y.	1890	m	l	s	r	.....	Oct. 3-10	6	7	Imperfectly tested.
30	Clinton	N. Y.	1891	s	s sh	s	r	June 21	" 3-10	3	10	Very acid till late.
31	Colerain	Ohio	1892	....	.....	....	.....	.....	.....	..	..	Awaits further trial.
32	Columbia	D. C.	1891	....	.....	....	.....	.....	.....	..	..	Vine a poor grower.
33	Concord	Mass.	1888	m l	l sh	m	r	June 21	Sep. 24-30	5	9	Standard market grape.
34	Cortland	N. Y.	1890	m	l	m l	.....	" 21	Aug. 27-Sep. 2	4	8	Very early.
35	Cottage	Mass.	1890	m l	m	m	r	" 22	Sep. 10-17	4	5	Not valuable.
36	Crevelling	Penn.	1890	l	l	m	r	" 26	" 3-10	8	5	Early. Thin bearer.
37	Delaware	N. J.	1888	s	sh	s	r	" 22	" 17-24	10	10	Has few superiors.
38	Diamond	N. Y.	1889	l	sh	l	r	" 27	" 13-17	8	10	Amateur and market.
39	Diana	Mass.	1868	m	m	m	r	" 26	Oct. 8-15	7	7	A long keeper. Foxy.
40	Downing	N. Y.	1889	l	sh	l	o	" 24	Sep. 24-Oct. 1	8	7	Hybrid. Keeps late.
41	Dracut (Amber)	Mass.	1890	l	l sh	l	r	" 24	Sep. 10-17	3	7	Utterly unworthy.
42	Duchess	N. Y.	1888	l	l sh	m	r o	" 29	" 17-24	10	5	Mildews badly.
43	Early Market	Texas	1889	s	s	s	r	" 23	" 10-17	2	2	Not desirable here.
44	Early Victor	Kan.	1888	m	sh	m	r	" 26	" 3-10	8	7	Promising.
45	Eaton	Mass.	1888	l	sh	l	r	" 26	" 17-24	5	8	Showy. Market.
46	Elaine	Mich.	1889	....	.....	....	.....	" 26	" 14-24	..	..	C. Engle. Try further.
47	El Dorado	N. Y.	1889	l	sh	l	r	" 29	" 17-24	8	..	One of Rickett's seedlings.
48	Elvira	Mo.	1890	s	s sh	m	r	" 28	" 10-17	2	10	Not valuable here.
49	Empire State	N. Y.	1888	l	sh	m	r o	" 29	" 17-24	8	7	Excellent. White.
50	Essex	Mass.	1889	m	s sh	l	r	" 27	" 24-30	5	6	Not valuable.
51	Esther	.....	.....	.....	.....	.....	.....	.....	.....	..	..	Not yet fruited.
52	Etta	Mo.	1890	s	sh	m	r	June 28	Sep. 24-30	2	8	A wine grape.
53	Eugenie	N. Y.	1891	....	.....	....	.....	.....	.....	..	..	Not yet fruited.
54	Eumelan	N. Y.	1888	m	sh	s m	r	June 24	Sep. 17-24	7	8	Has many good qualities.

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GRAPES—CONTINUED.

Number.	Name.	Origin.	Planted.	Bunch. 1, large; m, medium; s, small.	Bunch. 1, long; m, medium; s, short; sh, shouldered.	Berry. 1, large; m, medium; s, small.	Berry. r, round; o, oval.	First bloom.	Ripe.	Quality, 1 to 10.	Product, 1 to 10.	Remarks.
55	Eva	Penn..	1889	s	s	m	r	June 24	.....	3	--	Unworthy.
56	Excelsior	N. Y..	1889	l	sh	l	r	.....	Sep. 6	8	--	Of doubtful value.
57	Faith	Mo. ..	1891	....	.....	....	.....	.....	.....	--	--	Not properly tested.
58	Gaertner	Mass.	1889	m	.....	m l	.....	June 30	.....	--	--	Needs longer trial.
59	Geneva	N. Y..	1891	....	.....	....	.....	" 26	.....	--	--	Not yet fruited.
60	Goethe	Mass.	1889	m l	sh	l	o	" 26	Oct. 1-8	5	--	Too late for the north.
61	Golden Drop	N. Y.?.	1889	s	s	s	r	" 27	Sep. 10-17	9	--	Vine unsatisfactory.
62	Golden Gem	N. Y..	1890	s	sh	s	r	.....	" 24	10	--	Vine a slow grower.
63	Guinevra	Mich..	1891	....	.....	....	.....	.....	.....	--	--	C. Engle. Not yet fruited.
64	Hall	Mich..	1893	....	.....	....	.....	.....	.....	--	--	Not yet fruited.
65	Hartford	Conn..	1889	l	l sh	m	r	June 24	Sep. 10-17	2	10	Too poor. Fruit drops.
66	Hayes	Mass..	1888	m	sh	m	r	" 24	" 10-17	8	9	Excellent. White.
67	Herbert	Mass..	1889	l	m sh	l	r	" 26	" 10-17	7	8	Of fair quality.
68	Highland	N. Y..	1889	l	l sh	l	r	" 30	.....	5	9	Does not ripen here.
69	Honey	Mich..	1891	....	.....	....	.....	.....	.....	--	--	C. Engle. Further trial.
70	Iona	N. Y..	1888	l	l sh	m	o	June 22	Sep. 17-24	10	5	Best, often fails.
71	Iris	Mich.	1891	....	sh	l	r	" 22	" 17-24	8	--	The first fruit.
72	Isabella	S. C.?.	1888	l	l sh	l	o	" 24	Oct. 8-15	9	9	Needs a long season.
73	Ives	Ohio..	1890	m l	sh	m	o	" 24	Sep. 10-16	4	9	A market grape.
74	Janesville	Wis.?.	1889	s	s sh	m	r	" 21	" 27-30	4	10	Hardiness its chief merit.
75	Jefferson	N. Y..	1888	l	sh	m	r	" 29	Oct. 8-15	9	10	A long keeper. Excellent.
76	Jessica	Ont..	1888	s	s	s	r	" 23	Aug. 27-Sep. 2	10	8	Rich. Early. Seedy.
77	Jewell	Kan..	1889	m s	s	m s	r	" 27	Sep. 3-10	8	8	New. Try further.
78	Josselyn 5-2-1	N. Y..	1890	m	m sh	l	r	" 26	" 17-24	6	--	Its first fruiting.
79	Josselyn 7-2-1	N. Y..	1890	....	.....	....	.....	.....	.....	--	--	Not fruited.
80	Josselyn 9-2-1	N. Y..	1890	....	sh	m	r	June 29	Sep. 24-30	5	--	First bearing.
81	Josselyn 10-2-1	N. Y..	1890	....	.....	....	.....	.....	.....	--	--	Not fruited.
82	Lady	Ohio..	1885	m s	s	m l	r	June 27	Sep. 10-17	9	7	Early. Sweet. Rich.
83	Lady Washington	N. Y..	1888	l	sh	m	r	" 27	Oct. 8-15	8	10	Ripens late. White.
84	Leader	Ohio..	1890	....	.....	m	r	" 21	.....	6	--	But partially tested.
85	Leavenworth	Kan..	1890	....	.....	....	.....	.....	.....	--	--	Not yet fruited.
86	Lindley	Mass.	1889	m l	sh	l	r	June 27	Sep. 10-17	7	--	One of the Rogers' hybrids.
87	Lutie	Tenn..	1890	m	s sh	m	r	" 22	" 24-30	2	9	Foxy. Sweet, worthless.
88	Martha	Penn..	1890	....	.....	....	.....	" 26	.....	--	--	Plant not true to name.
89	Mason	Mich..	1891	....	.....	....	.....	.....	.....	--	--	A Michigan seedling.
90	Massasoit	Mass..	1888	m	s	m l	r	June 22	Sep. 17-24	8	8	Anthracnose on fruit.
91	Merrimac	Mass..	1888	s	s	l	r	" 24	" 17-24	7	7	A vigorous grower.
92	Michigan	Mich..	1889	s	s	m l	r	" 27	" 10-17	7	--	Need further trial.
93	Mills	Ont..	1888	l	sh	l	r	" 27	" 17-27	8	9	A long keeper. Fine.
94	Minnesota	Minn..	1890	m	l	m	r	" 24	" 24-30	4	8	Showy. Not valuable.
95	Monroe	N. Y..	1889	m	sh	m	r	" 27	" 17-24	7	9	Seedling of western N. Y.
96	Moore Early	Mass..	1890	m	m	l	r	" 26	Aug. 27-31	4	6	For early market.
97	Moyer	Ont..	1888	s	s sh	m	r	" 27	Sep. 3-10	7	7	Very early. Amateur.
98	Naomi	N. Y..	1889	l	l sh	m	r o	" 29	Oct. 1-8	6	8	Value doubtful.
99	Nectar	N. Y..	1888	l	sh	s	r	July 5	Sep. 10-17	8	2	Unproductive. Poor foliage.
100	Niagara	N. Y..	1888	l	sh	l	r o	June 24	" 24-30	5	10	Vine vigorous, healthy.
101	Northern Light	Ont..	1890	m	l	m	r	" 28	" 17-24	8	--	Needs further trial.
102	Olita	Texas.	1889	....	.....	....	.....	" 29	.....	--	--	Needs further trial.
103	Oneida	N. Y..	1890	m	sh	l	r	" 26	Sep. 17-24	--	--	Give further trial.
104	Osage	Kan.?.	1890	....	.....	l	r	" 27	" 10-17	7	--	Needs further trial.
105	Owosso	Mich..	1890	l	s	l	r	" 28	" 17-24	5	10	Like Catawba, but earlier.
106	Ozark	Kan.?.	1890	m	s sh	m	r	" 28	.....	3	6	Not a table grape.
107	Palmer	N. Y..	1890	m	m	l	r	" 26	Sep. 10-17	6	5	Probably an old variety.
108	Peabody	N. Y..	1890	m	m sh	m	o	" 26	" 3-10	5	10	Flavor not pleasant.

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GRAPES—CONTINUED.

Number.	Name.	Origin.	Planted.	Bunch. l, large; m, medium; s, small.	Bunch. l, long; m, medium; s, short; sh, shouldered.	Berry. l, large; m, medium; s, small.	Berry. r, round; o, oval.	First bloom.	Ripe.	Quality, 1 to 10.	Product, 1 to 10.	Remarks.
				Size.	Form.	Size.	Form.					
109	Perkins	Mass.	1889	m	sh	m	o	June 24	Sep. 8-10	3	7	Foxy, very poor.
110	Pocklington	N. Y.	1888	l	sh	l	r	" 26	" 24-30	6	8	Foxy, showy, late.
111	Poughkeepsie	N. Y.	1888	s	m sh	s	s sh	" 27	" 17-24	10	1	Nearly a failure here.
112	Prentiss	N. Y.	1888	m	m	m	r o	" 27	" 10-17	10	8	A good keeper.
113	President (Lyon)	Texas	1889	s	s	s	r	" 24	" 17-24	6	1	Unworthy so far.
114	Progress	Kan.?	1890	s	s	l	r	" 26		6	..	Not fully tested.
115	Pulpless	Mich.	1892	....	.....	....	.....	.....	.....	..	..	C. Engle. Not fruited.
116	Purity	Ohio	1889	m	l	l	r	June 27	Sep. 8-15	6	6	Identity doubtful.
117	Rents	Ohio	1889	l	sh	l	r	" 29	" 17-24	4	..	Needs further trial.
118	Requa	Mass.	1890	l	m sh	m	r	" 27	" 10-17	7	7	Another Rogers' hybrid.
119	Rochester	N. Y.	1890	l	m sh	m	r	" 22	" 10-17	6	10	Soon loses in flavor.
120	Rockwood	N. Y.?	1890	....	.....	....	.....	.....	.....	..	..	Not yet fruited here.
121	Rogers 5	Mass.	1889	m l	s	l	r	June 27	Sep. 17-24	7	..	Sweet and rich.
122	Rogers 8	Mass.	1889	m	m	l	r	" 26	" 24-30	5	7	Rather late.
123	Rogers 24	Mass.	1889	m	m	l	r	" 27	" 17-24	4	7	Bunch often small.
124	Rogers 30	Mass.	1889	l	m	l	r	" 27	Oct. 1-8	6	..	Bunch often imperfect.
125	Rommell	Texas	1889	m	m sh	m	r	" 26	Sep. 17-24	3	6	Too far north.
126	Salem	Mass.	1888	l	s	l	r	" 24	" 17-24	6	7	Largest of Rogers' hybrids.
127	Secretary	N. Y.	1890	l	l sh	m	r o	" 24	" 10-17	10	9	Vine unhealthy.
128	Telegraph	Penn.	1890	m l	sh	m l	r	" 24	" 3-10	6	8	One of the early natives.
129	Themis	Mich.	1891	....	.....	....	.....	.....	.....	..	..	Engle. Not yet fruited.
130	Triumph	Ohio	1890	l	l sh	l	r	June 29	Oct. 15-22	8	10	Will not ripen here.
131	Ulster	N. Y.	1888	m	sh	m	r	" 22	Sep. 8-15	9	10	Excellent. Red.
132	Vergennes	Vt.	1890	m	l	l	r	" 24	" 24-30	6	7	A market grape.
133	Vesta	Mich.	1891	....	.....	....	.....	.....	.....	..	..	Engle. Not yet fruited.
134	Victoria	N. Y.	1890	l	l sh	m	r	June 25	Sep. 24-30	3	10	Variety is spurious.
135	Warder	Ill.	1892	....	.....	....	.....	.....	.....	..	..	From Div. Pom. Not fruited.
136	Wells	Mo.	1890	s	s	m	r	June 24	Sep. 8-15	2	..	Needs further trial.
137	White Ann Arbor	Mich.	1888	....	.....	....	.....	.....	.....	..	..	Has failed to fruit here.
138	White Beauty	Kan.	1890	....	.....	s	r	June 25	Sep. 17-24	6	..	Needs further trial.
139	White Imperial	Kan.	1890	s	s	s	r	" 22	" 3-10	8	..	Promising, white.
140	Wilder	Mass.	1888	l	sh	l	r	" 24	" 17-24	8	8	One of Rogers' best.
141	Willis	Ill.	1890	m	sh	m	r	" 26	" 10-17	..	..	Plant probably spurious.
142	Winchell	Vt.	1889	l	sh	m	r	" 26	Aug. 27-30	10	10	Best of its season, early.
143	Witt	Ohio	1889	....	.....	....	.....	" 29	Sep 17-24	7	7	White Concord seedling.
144	Woodruff	Mich.	1888	l	s sh	l	r	" 24	" 24-30	4	7	Varies in quality.
145	Worden	N. Y.	1888	l	s	l	r	" 24	" 17-24	6	8	An improved Concord.
146	Wyoming	N. Y.	1888	s	sh	s m	r	" 24	" 10-17	3	6	Of little value.

Agawam is one of the numerous Rogers' hybrids, of fair quality. It keeps till March, with ordinary care, in a cool cellar.

Aminia is, by some good judges, considered the best of the Rogers' hybrids.

Beagle, Bell, Blanco, Brilliant, Campbell, Olita, President (Lyon), and Rommell, all seedlings of T. V. Munson of Texas, are now just in bearing, with little apparent promise, so far, of value in this, to them, far northern region. The fruit mildews badly, although thoroughly sprayed.

Brighton is very vigorous and productive, planted as it is here among other varieties, which may be supposed to insure the more perfect fertilization of its bloom. In quality it has few if any superiors, though it

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soon begins to deteriorate, not retaining its fine flavor beyond early December.

Caywood (No. 50) was received in 1888 or 1889 for trial, from its originator, the late A. J. Caywood of Marlboro, New York. It has now fruited two or three years, giving promise of value for the market.

Chidester, Nos. 1, 2, 3 and 4, are Labrusca seedlings, by C. P. Chidester of this State, which give decided promise of value. Nos. 1 and 2 were exhibited for premium at the State fair in 1887, and the first premium was awarded to No. 1 by the State Horticultural Society, which named it President Lyon, the same name having been subsequently bestowed by T. V. Munson of Texas upon one of his seedlings (see tabular No. 113). The quality of No. 1 is excellent but, so far, it is a very thin bearer.

Cortland has, this season, produced a bountiful first crop here. It is very early, even earlier than Moore; large, black; it has a possible value as a market grape for that reason.

Delaware, here, proves quite as productive and profitable as Concord, since its beauty and superior quality, notwithstanding its diminutive size, insure higher prices in the market.

Diamond is early; both bunch and berry large; the plant is vigorous and productive. Its good quality and showy appearance render it a special favorite with the birds.

Goethe (a Rogers' hybrid), Highland (a Ricketts' hybrid) and Triumph, a hybrid by Campbell of Ohio, are all too late for the latitude of Michigan, save under exceptionally favorable conditions.

Guinevra, Honey, Iris, Michigan, Pulpless, Thermis and Vesta are seedlings originated by C. Engle of Michigan. So far as tested, several of them are of good quality. Several, if not all of them, are vigorous. A longer trial is needful.

Hayes, of medium season; Lady, early; Pocklington, rather late, and Lady Washington, still later, are amateur white grapes, with the exception of Pocklington, scarcely adapted to the market.

Iona stands out prominently as the finest of the high flavored class of American grapes. The late Edward Bradfield of Ada, Michigan, was eminently successful in growing and fruiting it, and the same, for a time, was true of Judge Ramsdell, even as far north as Traverse City, and yet, with most growers, it has proved a sad failure.

Isabella, one of the oldest of our native varieties, where it can be fully ripened, still stands high, even as a dessert grape. It is also a good keeper.

Janesville is valuable, if at all, for its earliness and abundant hardiness, which render it useful in trying locations in which better varieties would be likely to fail.

Jefferson, a cross of Concord and Iona, by Ricketts, is among the most desirable of long keepers. Its flavor is mild and pleasant and the pulp is very tender. It can be kept till March without special care.

Jessica is a very early white grape; small, white and very sweet; seeds large for the size of the berry.

Jewell, originated by the late John Burr of Kansas, is rather small in both bunch and berry, but, on account of its earliness and generally good qualities, it is one of the most desirable of black amateur grapes.

Of four varieties received for trial from Josselyn of New York, two have now fruited here, for the first time, one a black grape and the other

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white. Both are promising, although they require more extended trial. They are yet nameless.

Lutie has been several years before the public and, so far, meets nearly universal condemnation. Although sweet, it is intolerably foxy. Undesirable for any purpose.

Niagara has apparently already acquired an assured position as the leading white market grape. Though not superior, if even equal to Concord in quality, here at least it is even more productive.

Owosso, a Michigan seedling, is somewhat like its reputed parent, the Catawba, though shorter in bunch and earlier in season.

Palmer is a large black grape, found growing in a garden here by the person whose name it temporarily bears. Since including it in the foregoing table, we learn that it is a seedling originated in New York by Mrs. Millington, who subsequently removed to this place, bringing the variety with her. Such being the fact, it should doubtless bear her name, rather than that here given. From its trial thus far, it seems likely to prove desirable as a market variety.

Poughkeepsie is very much like Delaware in fruit but, so far as grown here, the plant is the least vigorous and productive one upon the premises. It may be fairly considered worthless, certainly so here.

The variety received and fruited here as Purity, in color and general appearance of fruit might appropriately bear that name, but it is clearly not the genuine variety, as named and described by Geo. W. Campbell, the originator.

Rochester, originated by Ellwanger & Barry of Rochester, New York, is of fair quality, bunch large, and the plant a good grower and an abundant bearer.

Secretary, one of the best of the Ricketts' hybrids, so far as the fruit is concerned, but the plant is far from satisfactory, being of feeble habit and specially liable to mildew.

Ulster is high in quality and the plant very productive, though slightly lacking in vigor.

Winchell. This variety has been several years before the public under this name, which is that of the originator or discoverer. Originating, as it did, in Vermont, it has more recently been disseminated from a New England nursery as Green Mountain. Under pomological rules, the earlier name, being an appropriate one, is clearly entitled to precedence. The plant is vigorous and productive, and the fruit very early and of excellent quality.

Martha, as received and tested here, proves spurious, being a black grape.

Massasoit, Merrimac, Salem and Wilder are valuable, well known Rogers' hybrids; too generally known to require description or characterization.

Moore (Early) occupies a somewhat doubtful position as an early market grape of the Concord type. It has several competitors of higher quality.

Moyer is very early, sweet and pleasant. Bunch and berry rather small. An amateur grape only.

Nectar has small, imperfect foliage and has, so far, proved very unproductive.

Woodruff, named for its originator, a resident of Ann Arbor, Michigan, is a large, bright red, Concord seedling sometimes of very good quality but

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variable. The plant is very vigorous, and occasionally over productive to such extent as to seriously affect the quality of the fruit.

Worden is a typical Concord seedling, with a larger bunch and berry, of somewhat improved quality, as well as earlier. It is, to some extent, popular as a market variety.

Wyoming, occasionally known as Wilmington Red is, at the best, but a slight remove from the wild type and, with the many more recent and greatly improved varieties, it can scarcely be considered worthy of cultivation.

PLUMS (*Prunus*).

Insects have been less persistent, than in previous years, in their attacks upon the foliage and fruit of the plum.

A little Paris green was applied in connection with the spray, but jarring has been the chief reliance for defense against the "Little Turk."

Upon a few trees, growing in light soil, the rose chafer (*Macrodactylus subspinosus*), has been troublesome, as has been the case for several years; since poisonous sprays prove ineffectual hand picking was resorted to for their suppression.

The slug (*Eriocampa cerasi*), has been less troublesome this season than last and has yielded readily to a spray of tobacco water.

In common with the entire plantation, the plums received a spray of Bordeaux late last autumn.

On April 10 and 11, last, they were given a spray composed of 4 lbs. copper sulphate, 3 lbs. stone lime and 2½ oz. Paris green in 32 gals. water.

On June 8 they were again sprayed with the same preparation.

On June 28 a spray of kerosene emulsion was applied to subdue the slug, using ¾ lb. soap, 2 gals. kerosene in 10 gals. water.

July 14 and 15 a spray was applied, using 2 lbs. copper sulphate, 1½ lbs. lime and 2½ oz. Paris green in 32 gals. water. Several varieties of plums lost more or less of their older foliage, apparently as the result of this last application. (Due probably to the use of air slaked lime.)

Aug. 7 and 8 they received a final spray of tobacco water, to subdue the slug which had again appeared in considerable numbers.

The following table includes only such varieties of plums as have bloomed and fruited (one or both) this year.

The species to which several of these varieties should be assigned is yet an open question among botanists for which reason, in such cases, a mark of doubtfulness is appended.

This being the first crop of nearly all the varieties of plums here tabulated and the crop, in most cases, comprising but few specimens, it seems inexpedient to venture upon descriptions or estimates of values. These are, therefore, deferred to await subsequent developments.

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PLUMS.

No.	Name.	Species.	Planted.	Bloomed.	Ripened.
1	Bailey	Domestica	1889	May 22	Aug. 30.
2	Black Prune	Domestica	1888	" 22	Sept. 1.
3	Botan	Hattan	1890	" 19.	
4	Bradshaw	Domestica	1890	" 22.	
5	Burbank, 2	Domestica?	1890	" 18.	
6	Burbank, 11	Domestica?	1890	" 19.	
7	Cheney	Americana	1888	" 20	" 1.
8	Cook (Choice)	Americana?	1890	" 24.	
9	De Soto	Americana	1888	" 22	" 15.
10	Englebert	Domestica	1890	" 24.	
11	Forest Garden	Americana	1889	" 22.	
12	Forest Rose	Hortulana var. Mineri	1890	" 24.	
13	Golden (Beauty)	Hortulana	1890	" 27	Oct. 7.
14	Hawkeye	Americana	1888	" 22.	
15	Jewell		1890	" 27.	
16	Kingston	Domestica	1890	" 19.	
17	Long Fruited	Hattan	1890	" 22.	
18	Maquoketa	Americana	1888	" 24	" 7.
19	Marianna	Cerasifera Hyb.?	1890	" 27.	
20	Merunka	Domestica	1888	" 22	Aug. 16.
21	Masu	Hattan	1890	" 19.	
22	Miner	Hortulana var. Mineri	1890	" 24.	
23	Moore (Arctic)	Domestica	1890	" 18.	
24	Moreman	Hortulana	1890	" 20.	
25	Ogon	Hattan	1890	" 20	" 11.
26	Pottawatomie	Angustifolia	1888	June 1	" 14.
27	Prairie (Flower)	Hortulana var. Mineri?	1890	May 24	Oct. 10.
28	Red Nagate	Hattan	1890	" 27.	
29	Robinson	Angustifolia	1890	" 30	Sept. 8.
30	Rollingstone	Americana	1888	" 22	" 7.
31	Satsuma	Hattan	1890	" 22	Oct. 5.
32	Shiro Sinomo	Hattan	1890	" 19	Aug. 12.
33	Simon	Simoni?	1888	" 15	" 12.
34	Twenty Orel	Domestica	1888	" 22.	
35	Van Buren	Americana var.	1890	" 23.	
36	Weaver	Americana	1890	" 22.	
37	White Nicholas		1890	" 22.	
38	Wolf	Americana	1888	" 24	Sept. 14.
39	Yosebe	Hattan	1890	" 15	July 26.
40	Moldovka	Domestica	1888	" 22	Aug. 22.

Bailey is the name temporarily attached to a variety of the common garden plum of the east, which was received, in scion, from S. S. Bailey of Kent county, Michigan. It proves to be very vigorous, of upright habit and the fruit is of more than medium quality and size. It has produced a few fruits this season for the first time here.

Black Prune, Merunka, Moldovka and Twenty Orel are varieties imported by Prof. Budd, of Iowa, from northeastern Europe. They are of the *domestica* species and, should they prove productive, may be found desirable here.

Botan, (foisted upon the public as *Abundance*, for the apparent purpose of promoting sales) Long Fruited, Masu, Ogon, Red Nagate, Satsuma, Shiro Sinomo and Yosebe are varieties coming from Japan. Satsuma is of a type distinct from all others. It is large, round and very dark purple in both skin and flesh. Yosebe is notable for its extreme earliness, it being more than a week in advance of any other variety though not of high quality.

Bradshaw, Englebert, and Moore (Arctic) are extensively known as market varieties, wherever the *domesticas* are successful.

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Burbank Nos. 2 and 11 are understood to have originated with that noted experimenter, Luther Burbank of California. They have blossomed here the past season but have not fruited.

Cheney, Cook, DeSoto, Forest Garden, Forest Rose, Golden (Beauty), Hawkeye, Jewell, Maquoketa, Miner, Moreman, Pottawatomie, Prairie (Flower), Rollingstone, Van Buren, Weaver and Wolf are all more or less generally known and valued, at the north and west, where the finer eastern varieties fail.

Kingston and (White) Nicholas have had but a short and imperfect trial here and have not yet shown their qualities sufficiently for characterization.

Marianna is far better known for its ability to root readily from cuttings and afford a supply of stocks for the nursery than for its value as a producer of fruit.

Robinson proves to be a vigorous grower and has, the past season, produced a fine crop of good sized, pleasant-flavored fruit; quite superior to most if not all the native western varieties that have so far fruited here.

Simon (Prunus Simoni of nursery catalogues), has now fruited here profusely; the large, bright colored, very peculiar fruit, as grown here, is far from agreeable in flavor. Botanists seem to consider it a sort of Ishmaelite among plums having specific characteristics peculiar to itself.

PEARS. (*Pyrus communis.*)

The unprecedented drouth of the past season had, apparently, little injurious effect upon the pear, perhaps on account of the deep rooting habit of the species.

The spray of Bordeaux, given late in the autumn of 1892, was followed on June 12, 1893, with a spray composed of 4 lbs. copper sulphate, 3 lbs. lime and 2½ oz. Paris green in 32 gallons of water.

On June 28 the pears received a spray of kerosene emulsion, applied to subdue the slug (*Eriocampa cerasi*).

On July 10 to 13 a final spray was applied, consisting of 2 lbs. copper sulphate, 1½ lbs. lime and 2½ oz. Paris green in 32 gallons of water. This application, which injured the foliage of peaches, plums and cherries, occasioned no preceptible injury to that of pears.

The blight which, late in 1892, ruined a few pear trees, has again appeared this season, upon a tree of Seedless (Bessemianka), which, when discovered, were promplty cut back to apparently healthy wood. Indications, however, point to its probable reappearance next season. This appearance of blight in two successive seasons, in both cases upon Russian varieties, may be supposed to indicate a special liability to such attacks; since both were standing upon rather moist soil, this might be supposed to have induced the attack, but for the circumstance that they were alternated with Bosc, Anjou and Mount Vernon, which remain in obviously healthy condition.

The foliage of the pears has been exempt from leaf spot (*Fusicladium dendriticum*) (which attacks both foliage and fruit of the apple and pear), except that three or four trees of Jones and Mount Vernon pears (which perchance may have been omitted in the spraying), have been seriously attacked.

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The following varieties have bloomed this season, and a few fruits have been brought to maturity.

No.	Variety.	Bloom.	Ripened.	Remarks.
1	Ansault	May 22	Nov. Dec.	European. Promises well.
2	Bloodgood	" 22	Aug. 28	An excellent amateur pear.
3	Clapp Favorite	" 29	Sept.	Large, good; soon rots at the core.
4	Dana Hovey	" 24	Winter	A small fruit, of high quality.
5	Gakovska	" 24		An importation from Russia.
6	Howell	" 22	Oct.	A good market and home fruit.
7	Lawrence	" 22	Winter	A desirable winter variety.
8	Lucrative	" 27	Sept.	A superior pear for home use.
9	Mount Vernon	" 23	Nov. Dec.	A very good amateur pear.
10	Rostiezer	" 27	Aug.	Not beautiful, but excellent.
11	Seckel	" 27	Oct.	The standard of high quality.
12	Victorina	" 24		Russian, not yet fruited.
13	Winter Nelis	" 27	Dec.	The prince of winter pears.

APPLES (*Pyrus malus*).

The severe attack of scab, *Fusicladium dendriticum*, of last year so enfeebled the apple trees that, in most cases, few fruit buds were developed and, doubtless for this reason, at least in part if not wholly, there was a decided paucity of bloom last spring. There were, however, a few notable exceptions, prominent among which were the Keswick and Oldenburg, both of which were, in a great measure, exempt from scab last year, and have produced fine crops of perfect fruit this season.

The green aphis (*Aphis mali*) has proved somewhat persistent this season, yielding reluctantly to sprays of kerosene emulsion, and tobacco water, both of which were applied in turn. No other insects have, to a serious extent, infested the apple during the season, except that a very few fruits were found to be inhabited by the larvæ of the codling moth, which were promptly gathered up and effectually disposed of.

A very considerable number of varieties of apple (as well as of other fruits) were received, in cion, from the National Division of Pomology, on the 28th of March last, coming originally, as is understood, from eastern or northeastern Austria. These were topgrafted upon trees in orchard, heretofore planted for such purpose, and also cions of each variety were inserted in nursery stocks, as a precaution against the loss of a variety. These are expected to be in condition to be planted out the coming spring.

Aside from the general spraying in November, 1892, which included the apple, additional sprayings have been applied as follows:

On June 12, a spray composed of 4 lbs. copper sulphate, 3 lbs. lime and 2½ oz. Paris Green, in 32 gallons of water.

On June 22, a spray of kerosene emulsion, to subdue the aphis.

On August 5 to 8, a spray of strong tobacco water, for the same purpose.

Whether as the result of the sprayings specified, or otherwise, the foliage of the present season has nearly or quite resumed a healthy condition, and the trees generally have nearly or quite recovered their pristine condition.

The following varieties have bloomed and matured fruit the past season:

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No.	Name.	Bloomed.	Ripened.	Remarks.
1	Borovinka	May 24	Sept.	This proves to be identical with Oldenburg (as pr. Downing, page 102).
2	Keswick (Codlin)	" 23	Oct.	This resists the scab, having fruited last year and produced a heavy crop this year.
3	Titovka	" 29	Sept.	
4	Winter Streifling	" 25	Oct.	

It will be observed that Nos. 1, 3 and 4 are Russian or East European varieties, while No. 2 is English. This last has no superior if indeed it has an equal in this climate as a hardy tree, bearing early and profusely. It is strictly a culinary fruit, for which purpose it scarcely has an equal.

QUINCES (*Cydonia*).

The quince during the two years last passed has been notably free from insect depredations. The vigorous condition of the plants may perchance have contributed to this apparent exemption, since many insects seem to avoid healthy vigorous trees, devoting themselves rather to such as may be enfeebled or diseased.

The slug (*Eriocampa cerasi*) made its appearance at the usual season.

There has been no indication of fungus upon either plant or fruit, which was undoubtedly due to the use of fungicides, as in former years there has been much injury from leaf-blight.

The plants were treated with a spray of kerosene emulsion on June 20 to subdue the slug, and a spray of tobacco water was applied on August 5 to 8 for the same purpose and with similar result.

Varieties of quince have bloomed and fruited this season as follows:

No.	Name.	Bloomed.	Ripened.
1	Alaska	May 7	No fruit.
2	Champion	June 5	Last of October.
3	Fuller	May 18	No fruit.
4	Meech	June 5	Last of October.
5	Missouri (Mammoth)	" 5	No fruit.
6	Orange	" 5	October.
7	Rea	" 5	October.

Champion is vigorous and very prolific but rather late.

Meech is in season about with Champion.

Orange is yet at the head, so far as season and general desirability are concerned.

Rea is much like Orange so far as appearance and size are concerned.

NUTS.

Seedlings from the large native Hathaway chestnut (*Castanea vesca*), planted in 1888, have this season shown a few catkins, but failed to set fruit.

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Paragon, which has for three or four seasons produced only abortive nuts, has this season ripened a very large crop (for so young a tree), the branches being so heavily loaded with the large burs that more than half were removed early in the season to insure the development of the remainder. The nuts were frequently three in a bur, of the usual size of the imported ones, and superior in quality, ripening about with our natives.

Among the varieties received and planted as Japanese chestnuts, one received as "Japanese Imported, grafted," planted in 1890 and now less than seven feet in height, has this season ripened a fine crop of large nuts. The burs are even smaller than those of our natives, usually containing but a single large round nut. They ripen at the usual season.

The European or Spanish chestnut, planted in 1890, has also shown a little fruit the past season.

CHINQUAPIN (*Castanea pumila*—or Dwarf chestnut).

Owing to the inability of this to bear transplanting, the nuts have been two or three times obtained and planted, but so far without success. Another lot has been obtained and planted this fall, the nuts coming from Tennessee.

PECAN (*Hickoria olivæformis*).

Nuts of pecan were received from southern Iowa and planted here in the fall of 1888. They prove hardy, so far, and this season have made good growths. The Stuart pecans, received from the Division of Pomology, have grown and have been protected for the winter, since, coming as they do from Texas, their hardiness in the climate of Michigan must be regarded as very doubtful.

ENGLISH WALNUT, OR MADEIRA NUT (*Juglans regia*).

This was planted in 1889 and, so far, has not winter-killed and has made moderate, healthy growths.

Dwarfs of this species, under the name *Præparturiens*, were also planted in 1890 and have, so far, suffered no apparent injury from our winters.

JAPAN WALNUT—(*Juglans Seiboldi.*)

This was planted in 1890, and has proved perfectly hardy here. It is a very vigorous grower, and has matured fruit here this season. In both tree and fruit it is much like our indigenous Butternut, though more vigorous. So far the fruit is scarcely equal to the Butternut.

ALMONDS—(*Amygdalus communis.*)

The Luelling almond, received from a Missouri nursery and planted in 1892, has proved hardy here, but has not yet fruited.

The "Soft Shelled Almond," planted here last year, proves hardy so far.

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FILBERTS AND HAZEL-NUTS—(*Corylus.*)

The Kentish Cob Filbert planted in the spring of 1892 has withstood the past winter unharmed, and has made satisfactory growth this season. It is promises to fruit next season.

The unnamed Hazel-nuts from the Division of Pomology planted last spring may be expected to more fully develop their peculiarities during next season.

FIGS—(*Ficus carica.*)

The cuttings of Brunswick Fig from H. E. Van Deman rooted here last season, were planted permanenty last spring. They are showing partially developed fruit this fall, and have now been laid down and covered with earth and litter to protect them from the alternate freezing and thawing of winter.

SOUTH HAVEN, MICHIGAN,
Nov. 24, 1893.

T. T. LYON.

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MICHIGAN FRUIT LIST.

Bulletin No. 105.

L. R. TAFT.

With the long list of varieties found in the fruit catalogues of our State and National horticultural societies, and the even more confusing ones in the nurserymen's list, it becomes a difficult matter to make a desirable selection, unless a person has a definite knowledge of the varieties that succeed best in the locality where he lives.

While a few varieties seem to thrive in nearly all sections, others that may be very valuable in some localities, are nearly worthless elsewhere, owing to the unsuitable conditions of climate or soil. It will be impossible, then for any one list to suit the wants of all persons. In order to learn the opinion of the growers in the different sections of the State as to the best varieties for their respective localities, a circular was last summer sent to some two hundred fruit growers asking their aid in the preparation of a fruit list for Michigan. The circular contained the last fruit list for this state issued by the American Pomological Society, and the varieties there given were marked by the correspondents with various symbols to indicate their value for the different localities. In several instances the lists were considered by the local horticultural societies, and votes were taken to determine the mark that should be given them.

The symbols used to indicate the value of the different varieties were as follows: two stars (**) when they were generally successful in the particular locality and were worthy of being placed in every list; one star (*) for varieties that were less generally successful and that were of less value than those given two stars; a dagger (†) indicated new and promising varieties and a dash (—) that the varieties were of no value and should be stricken from the list. A great difference of opinion was noticed in the returns, as, in a few cases, varieties were given two stars by some persons while others in the same county marked them with a dash. As a rule, however, a remarkable unanimity of opinion was shown, not only

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in the different counties, but in the dozen or more counties that go to make up one of the sections. So far as concerns the varieties marked with two stars, there seems to be but little difference in the rating given them, except that they are occasionally dropped out in the northern counties on account of their lateness or lack of hardiness.

The varieties marked with two stars in the following list were rated in that way by a majority of the correspondents in the different sections into which the State is divided, and, as will be seen they appear to be adapted to nearly all sections. Those marked with a single star received a minority of the votes for the two star list, or were regarded as worthy of one star by a considerable number of persons. The fact that a fruit is thus marked indicates that it has considerable value, but that as a rule the varieties with two stars are of more value and that, unless a long list is desired, it should not be selected. There are, for various reasons, exceptions to this rule, and so far as possible they will be explained in the notes that follow each class of fruits.

When a variety is marked with a star followed by an interrogation mark (* ?), it indicates that its use is favored by a few persons, but it is regarded as less desirable for general planting than those given one star. For certain purposes and in some localities it may be worthy of trial.

We have dropped from the list all varieties that were given a dash by a majority of those reporting upon them, or where there have not been as many as five persons from the entire State who thought them worthy of either one star, or a dagger.

The dagger has been here given to such new kinds as have been sufficiently tested in the State to warrant the statement that they are at least promising and worthy of trial upon a small scale. In the notes, mention is also made of some of the new varieties that have done well in other States but which have not yet been sufficiently tested in Michigan to determine their value, although most of them are under trial.

In dividing the State into sections we have placed in the Southern Lake Shore division all of the counties bordering Lake Michigan south of Muskegon, and in the Northern Lake Shore section all north of and including Muskegon. The two southern tiers of counties are considered to be in Southern Michigan; the three tiers north of this make up Central Michigan, and the counties north of Gratiot are considered as in Northern Michigan.

APPLES.

The list of apples will enable any intelligent person to select a collection that will be reasonably certain to succeed in his locality, and by noting the column marked "Use" the particular purpose for which they are valued can be learned.

Particular thought should be given to this as upon it the selection should depend. In making out a list for home use, we should not only select kinds that are healthy, vigorous trees and abundant bearers, but it should include both sweet and tart sorts, and afford a supply throughout the season of both dessert and cooking varieties. To secure this, one will need to have from fifteen to twenty varieties in the orchard designed for family use. Of the summer and fall sorts one, or at most two, trees of a kind will answer unless fruit is desired to sell or give away, but of the win-

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ter sorts a larger number is desirable, in order to be sure of a supply in years of partial failure; if there is a surplus at any time a ready sale can always be found for well grown fruit of desirable sorts.

APPLES.

ABBREVIATIONS.—SIZE—l, large; m, medium; s, small. FORM—r c, roundish conical; r ob, roundish oblate; r, roundish. COLOR—y r, yellow and red; r s, red striped; g y, greenish yellow; rus, russeted; y rus, yellow and russet. QUALITY—g, good; v g, very good; b, best. USE—F, family use; K M, kitchen and market; F M, family and market. SEASON—S, summer; E A, early autumn; L A, late autumn; W, winter. ORIGIN—Usual abbreviations for names of countries.

Names.	Description.							Value.				
	Size.	Form.	Color.	Quality.	Use.	Season.	Origin.	Southern Lake Shore.	Northern Lake Shore.	Southern Michigan.	Central Michigan.	Northern Michigan.
Alexander	l	r c	r s	g	K M	E A	Rus.	*	*	*	*	*
Autumn Bough	m	r c	g y	v g	F	E A	Am.	*?	*?		*?	
Bailey Sweet	l	r c	r s	v g	F M	L A	Am.	*	*	*	**	*
Baldwin	l	r c	r g	v g	F M	W	Am.	**	**	**	**	**
Belmont	l	r c	y r	b	F M	W	Am.	*	*	*	*	
Ben Davis	l	r c	y r	g	K M	W	Am.	**	*	*	**	*
Benoni	m	r ob	y r	v g	F M	S	Am.	*		*	*?	
Blenheim Pippin	l	r ob	y r	v g	F M	W	Eng.	*?		*?	*?	
Blue Pearmain	l	r c	r	g	M	W		*		*		
Bough	l	ob	g y	v g	F M	S	Am.	**	*	**	**	*
Bullock, (Am. Golden Russet)	s	r c	y rus	b	F M	W	Am.	*?		*	*	
Canada Reinette	l	r c	g y	v g	F M	W	F.	*?			*	
Chenango (Strawberry)	m	ob c	g r	v g	F M	E A	Am.	*	*	**	**	*
Clayton	l	c	y r	g	F M	W	Am.	*		†	†	
Colvert	l	r ob	y r	g	F M	L A	Am.	*	*?	*?	*	
Dyer (Pomme Royal)	m	r	g y	v g	F	E A	F.	*?		*?	*?	
Early Harvest	m	r ob	g y	v g	F M	S	Am.	*	*?	*	*	*
Early Joe	s	fl	y r	b	F	S	Am.	*	*?	*	*	
Early Strawberry	s	r	r s	v g	F	S	Am.	*	*	*	*	*
Esopus	l	ob	y r	b	F M	W	Am.	*	*	*	*	
Fallawater (*Tulpehocken*)	l	r c	g y	g	M	W	Am.	*	*	*	*	*
Fall Jenneting	l	fl	g y	g	M	E A	Am.	*		*?	*?	
Fall Orange	l	r	y r	g	K M	L A	Am.	*			*	
Fall Pippin	l	r ob	g y	v g	F M	L A	Am.	*		*?	*	*
Fameuse (*Snow Apple*)	m	r ob	r s	v g	F M	W	F.	*	*	*	*	*
Garden Royal	m	r ob	y r	b	F	S	Am.	*?			*?	
Gideon							Am.	†	†	†	†	†
Golden Russet (N. Y.)	m	r ob	y rus	v g	F M	W	Am.	*	*	*	**	*
Golden Sweet	l	r	g y	v g	F M	S	Am.	*	*	*?	*	
Golding	l	r ob	g y	v g	F M	W	Am.	*?	*?	*?	*?	
Gravenstein	l	r ob	y r	v g	F M	L A	Ger.	*	*	*	*	*
Grimes	m	r ob	g y	v g	F	W	Am.	**	*	**	**	
Hubbardston (*Nonesuch*)	l	r c	y r	v g	F M	W	Am.	**	**	**	**	
Jefferis	m	r ob	y r	v g	F M	E A	Am.	*	*	*	*	
Jersey Sweet	m	r	y r	v g	F M	E A	Am.	*	*	*	*	
Jewett Red	m	r ob	r	g	F M	W	Am.	*?	*?		*?	
Jonathan	m	r c	y r	v g	F M	W	Am.	**	**	**	**	**
Keswick	m	r c	g y	g	K M	E A	Eng.	*	*	*	*	
Lady	s	fl	y r	v g	F M	W	F.	*		*?	*?	
Lady Sweet	l	r	y r	v g	F M	W	Am.	*			*?	
Late Strawberry (*Autumn*)	m	r	y r	v g	F M	L A	Am.	*	*	*	*	*
Lowell (*Tallow Pippin*)	l	r c	g y	v g	F M	E A	Am.	*		*	*	
Maiden Blush	m	r	g y	g	F M	E A	Am.	**	**	**	**	*
Mann	m	r ob	y r	v g	F M	W	Am.	*	*?		*	*
Melon	m	r ob	y s	b	F M	W	Am.	*		*	*	

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APPLES.—CONTINUED.

Names.	Description.							Value.				
	Size.	Form.	Color.	Quality.	Use.	Season.	Origin.	Southern Lake Shore.	Northern Lake Shore.	Southern Michigan.	Central Michigan.	Northern Michigan.
Mohmouth	l	fl	yr	vg	F M	W	Am.	*		*?	*?	
Mother	m	rc	yr	b	F M	W	Am.	*	*?	*?	*	
Munson (*Orange Sweet*)	m	fl	yg	g	K M	L A	Am.	*	*?	*?	*?	
Newton (Spitzenburg)	m	rob	yr	b	F M	W	Am.	*		*	*?	*?
Northern Spy	l	rc	yr	b	F M	W	Am.	**	**	**	**	**
Oakland (Co. Seek-no-further)	m	rob	yr	vg	F	W	Am.	*	*	*?	*	
Oldenburg (Duchess of)	m	rob	yr	g	M	S	Rus.	**	**	**	**	**
Ortley (*White Bellflower*)	m	ob	gy	vg	F M	W	Am.	*		*	*?	
Peck	m	r	gy	vg	F M	W	Am.	*	*	*	*	*
Perry Russet	m	rc	rus	g	F M	W	Am.	*?		*?		
Pewaukee	l	fl	rs	g	F M	W	Am.		*?		*?	*?
Porter	l	ob	gy	b	F M	A	Am.	*	*	*	**	
Primate	m	rc	gy	b	F	E A	Am.	**	*	*	**	
Pumpkin Sweet (*Pound Sweet*)	l	robl	y	g	K M	E W	Am.	*?		*?	*?	
Rambo	m	fl	yr	vg	F M	L A	Am.	*	*	*?	*	*?
Rall	l	rc	yr	vg	F M	W		*	*	*?	*	*?
Red Astrachan	l	r	yr	g	K M	S	F.	**	**	**	**	**
Red Canada (*Steele's Red*)	m	rob	yr	b	F M	W		**	**	*	**	*
Rhode Island Greening	l	rob	gy	vg	F M	W	Am.	**	*	*	*	*
Ribston	m	r	yr	vg	F M	W	Eng.	*	*	*	*	*
Rome Beauty	l	r	yr	g	M	L A	Am.	*?		*?	*?	
Roxbury Russet	m	rob	yrus	vg	F M	W	Am.	*	*	*	*	*
Saint Lawrence	l	fl	yr	vg	M	A		*	*		*	*
Shiawassee	m	fl	ry	vg	F M	A	Am.	**	**	**	**	**
Smith (*Cider*)	l	rob	yr	g	F M	W	Am.	*		*?	*?	*?
Stark	l	rc	yr	g	F	W	Am.	**	*?	*	*?	
Summer Pearmain (*American*)	m	ob	yr	b	F	S	Am.	*			*?	*
Summer Pippin	m	obc	yr	g	K M	L S	Am.	*			*?	
Summer Queen	l	rc	yr	g	K M	S	Am.	*	*?			
Swaar	l	rob	gy	b	F M	W	Am.	*	*		*	*
Tetofsky	m	flc	yr	g	K	S	Rus.	*	*	*?	*	*
Talman	m	r	gy	vg	K M	W	Am.	**	**	**	**	**
Tompkins King	l	r	yr	vg	F M	W	Am.	**	**	*	**	**
Twenty Ounce (*Cayuga Red*)	l	r	rs	vg	F M	L A	Am.	**	**	*	**	*
Wagener	m	rob	yr	b	F	W	Am.	**	**	*	**	**
Walbridge	l	rob	rs	vg	F	W	Am.	†	†	†	*?	*?
Wealthy	m	rob	r	vg	F M	W	Am.	*	**		*	**
Westfield (Seek-no-further)	l	rc	yr	b	F M	W	Am.	*	*	*	**	*
Williams	m	rc	yr	g	M	S	Am.	*		*	*?	
Winesap	m	r	yr	vg	F M	W	F.			*	*	
Wolf River	l	rob	r	g	F M	W	Am.	*			*?	
White Bellflower	l	ob	gy	vg	F M	W	Am.	*	*	*	*	
Yellow Newtown	l	rob	gy	vg	F M	W	Am.	*	*	*?	*	
Yellow Transparent	m	rob	y	g	K M	E S	Rus.	*	*	*	*	

For nearly all sections of the state the following twenty varieties will make a good family collection:

Red Astrachan, Bough (Sweet), Oldenburgh, Primate, Chenango, Keswick, Maiden Blush, Shiawassee, Twenty Ounce, Bailey (Sweet), Westfield, Jonathan, Hubbardston, Grimes, Baldwin, Talman, King, R. I. Greening, Red Canada, N. Spy, and Golden Russet (N. Y.).

As a second choice some of the following could well be used: Early Harvest, Yellow Transparent, Tetofsky, Williams, Early Strawberry, Early Joe, Alexander, Lowell, Gravenstein, Fameuse, Colvert, Porter, Fall Pippin, St. Lawrence, Jefferis, Bullock, Canada Reinette, Wealthy, Esopus, Late Strawberry, Oakland, Mother, Peck, Rambo, Rall, Swaar, Winesap,

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Yellow Bellflower, and Roxbury Russet. Wagener succeeds well in the northern counties, and there would be in the two star list.

Of the varieties given in the second list, President Lyon recommends the following for a place in the first list for a family collection: Early Harvest (or Yellow Transparent), Early Strawberry, Jefferis, St. Lawrence and Roxbury Russet. He would also retain in the fruit list such apples as Cogswell, Manomet, McClellan and Mexico, which are certainly valuable sorts for dessert or cooking purposes.

In the third class, marked * ?, are such kinds as Autumn Bough, Blenheim, Dyer, Fall Jenneting, Fall Orange, Garden Royal, Golding, Jersey Sweet, Perry Russet, Pewaukee, Rome Beauty, Stark, Summer Queen, Summer Pippin, and Wolf River.

Of these the Pewaukee, Stark, and Wolf River, have not been very generally tested; the Pewaukee and Stark have fruited in several localities, and the reports are generally favorable. Walbridge, Gideon, and Clayton are also new sorts, and although nothing can be stated with certainty, it would seem safe to try the Walbridge and Clayton in an experimental way, in all except the northern counties, while the Gideon, from its origin, should be as well adapted as any variety to the northern half of the southern peninsula.

It is hoped that some of the better of the Russian varieties will be found valuable for that section. We have about one hundred varieties here at the college, and a similar collection at Grayling, Crawford county, besides smaller numbers at various points in that section.

Upon the thin sand of the Jack pine plains they have grown for three years without injury either from the cold of winter, or the drought of summer. Some of those first planted at the college gave a few fruits in 1893, and among these the Charlottenthaler seems particularly valuable as an early summer variety. The tree is an early bearer; the fruit is large, light lemon yellow in color, and, although rather acid, it is of a pleasant flavor; it seems well worthy of a place in a collection intended for supplying fruit for a local market.

It should be stated that had the returns been accurately canvassed Fameuse would have been in the double star list, but its seedling Shiawassee has all of its good qualities and is, moreover, a better growing and more productive tree, and the fruit is but little injured from the scab which in some seasons nearly ruins the Fameuse. The growers familiar with both varieties in every case marked the Shiawassee with two and Fameuse with a single star. As the Shiawassee cannot always be obtained from nurseries, many planters will find the Fameuse useful to plant in its stead. (Among the nurserymen who have a stock of this valuable sort are Buttrick & Watterson, of Cascade, Mich.)

The Keswick seems to be quite a sure bearer, even in off years, and it is particularly valuable as a fall variety for cooking purposes, since it remains for a long time in season.

There is often a good local market for apples, and a collection suitable for that purpose may be desired by some planters. The varieties to be used should be selected with rather more regard to productiveness and high color than those designed for home use. Such varieties as Red Astrachan, Oldenburgh, Shiawassee, Twenty Ounce, Jonathan, Hubbardston, Baldwin, King, and Northern Spy, if planted in rather larger numbers than when intended for home consumption only, would furnish a supply for sale.

In planting an orchard to secure fruit for shipment it is unwise to

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choose too many varieties and one should be guided largely in his selection by the kinds that succeed best in his locality.

They should be productive, of good size and color and of, at least, fair quality. In nearly all parts of the State, where they are sufficiently hardy, the Baldwin and Northern Spy are valuable for planting in commercial orchards, although the latter is a long time coming into bearing. The Ben Davis is also largely planted, although it, as grown here, is much inferior to the same variety grown in Missouri and Illinois. Hubbardston and Westfield are much prized for their quality. Red Canada is very popular as a market sort in the central and eastern part of the State, its productiveness, high color and good quality making it especially desirable. In the northern counties, especially along the west side of the State, Wagener is in high esteem. Farther south it is less valued, as, unless thinned and given high cultivation, the fruit is small and the trees short-lived from their tendency to overbear. Of the varieties for winter use, none are more profitable than Tompkins King, although with good care the Jonathan in many localities is preferred, as its medium size, rich color and high quality make it sought for as a dessert apple and for sale at street fruit stands. Grimes Golden is also profitable in nearly all parts of the State. In planting a commercial orchard one should select the two or three sorts that do best in his locality.

Of the new sorts that do not appear in the fruit list the Sutton is well worthy of trial. It has long been grown in Massachusetts under conditions much like those in this State and it is there highly valued as a variety for both home use and market on account of its hardiness, productiveness and the high color and quality of the fruit. Among the other varieties that are desirable from their behavior elsewhere are Princess Louise, Early Colton and Carlough (sweet).

CRAB APPLES.

While this fruit is commonly grown for home use and local market, the quantity shipped is comparatively small. Little attention has been paid to the introduction of new varieties and, of those given in the following list, the Whitney is the only one that has not been in general cultivation for many years. As will be seen from the list the Hyslop and Transcendent are best known. The Montreal Beauty and Whitney are also desirable sorts.

APPLES.—CRABS.

Names.	Description.							Value.				
	Size.	Form.	Color.	Quality.	Use.	Season.	Origin.	Southern Lake Shore.	Northern Lake Shore.	Southern Michigan.	Central Michigan.	Northern Michigan.
Hyslop	l	r	r	g	F M	A	Am.	**	**	**	**	**
Montreal Beauty	l	r ob	y r	g	F M	A	Am.	*	*	*	*	*
Red Siberian	m	r	r	g	F M	A	F.	------	*?	*?	*?	*
Transcendent	l	r ob	y r	g	F M	A	Am.	**	*	**	**	**
Whitney	l	r fl	r	v g	M	S	Am.	*	*	------	*	**
Yellow Siberian	m	r	y	g	F M	A	F.	------	------	*	------	*

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APRICOTS AND NECTARINES.

In most parts of the State these fruits are not successfully grown as, if the blossoms escape the early spring frosts, the trees are short-lived. Along the west shore, however, and in favorable locations in Southern Michigan, fairly good results are obtained, particularly with apricots. The varieties mentioned in the list are among those best known, but for commercial planting it is probable that the apricot known as Harris, which is proving very profitable in New York will be preferable; the Acme is another sort that seems worthy of trial. From the behavior of the Russian apricots it is doubtful if any of them are desirable for planting.

APRICOTS.

ABBREVIATIONS.—SIZE—l, large; m, medium; s, small. FORM—r, roundish; r f, roundish flattened; r o, roundish oval; ob c, oblong compressed, COLOR—y o, yellow, shaded to deep orange in the sun; o r, orange with red cheek; o, orange. QUALITY—g, good; v g, very good; b, best. USE—All apricots being valued for the dessert, the letter F will signify that it is extra for the dessert, and F M that it is valued for the dessert and at the same time profitable for market. SEASON—E, early; M; medium; L, late in season of ripening. ORIGIN—F, foreign; Am, American.

Names.	Description.							Value.			
	Size.	Form.	Color.	Quality.	Use.	Season.	Origin.	Southern Lake Shore.	Northern Lake Shore.	Southern Michigan.	Central Michigan.
Breda	m	r	o	v g	F M	E	F.	*?	*?	*?	*?
Early Golden	s	r o	o	v g	F M	E	F.	*?	*?	*?	*?
Moorpark	l	r	y o	b	F M	L	F.	*?	*?	*?	*?

NECTARINES.

Names.	Description.							Value.			
	Size.	Form.	Color.	Quality.	Use.	Season.	Origin.	Southern Lake Shore.	Northern Lake Shore.	Southern Michigan.	Central Michigan.
Boston	l	r o	o r	v g	F	M	Am.	*?	*?	*?	*?
Early Violet	l	r	o r	b	F	E	F.	*?	*?	*?	*?
Stanwick	l	r o	o r	g	F	L	F.	*?	*?	*?	*?

BLACKBERRIES.

As with many other fruits, the varieties of blackberries that are best in size and flavor are deficient in hardiness. Where this quality is necessary to a high degree, recourse to such sorts as Stone and Snyder will be necessary. In most parts of the State, however, the Taylor will succeed and will be found preferable to those sorts, so far as size is concerned. The Agawam is in every way a desirable sort except that it has strong curved spines, that render picking unpleasant. Erie, Kittatinny, Lawton, Wilson and Wilson Junior will be found excellent sorts where they have the necessary hardi-

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ness. Although so deficient in hardiness as to require laying down in winter, the Early Harvest is very largely grown as a commercial variety in Berrien county, and its productiveness and earliness make it a very profitable sort.

BLACKBERRIES.

ABBREVIATIONS.—SIZE—l, large; m, medium; s, small. FORM—ob c, oblong conic; r c, roundish conical or oval; ob ov, oblong oval. COLOR—b, black. QUALITY—g, good; v. g., very good; b, best. USE—F M, family and market; M, market. SEASON—M, medium: E, early; L, late. ORIGIN—Am, American; F, foreign.

Names.	Description.							Value.				
	Size.	Form.	Color.	Quality.	Use.	Season.	Origin.	Southern Lake Shore.	Northern Lake Shore.	Southern Michigan.	Central Michigan.	Northern Michigan.
Agawam	l	ob ov	b	v g	F M	M	Am.	*	------	*?	*	------
Ancient Briton	m	ov	b	g	F M	VE	Am.	*	------	*?	*	------
Early Harvest	l	ob ov	b	g	F M	M	Am.	*	------	*	*	------
Erie	l	r c	b	b	F M	M	Am.	*	*?	*?	*?	------
Kittatinny	l	ov	b	g	M	L	Am.	*	*?	*?	*?	------
Lawton	l	ob ov	b	v g	F M	VE	Am.	*	------	------	------	------
Lucretia	l	ov	b	g	M	M	Am.	------	†	*?	*	------
Minnewaski	m	r ov	b	v g	F M	E	Am.	**	**	**	**	*
Snyder	l	ob	b	g	F	------	Am.	*	*?	*?	*?	*
Stone (Hardy)												
Taylor, *Taylor's Prolific*	l	ob ov	b	g	F M	M	Am.	**	*	**	**	*
Wachusett	m	ob ov	b	v g	F M	M	Am.	------	*?	*?	*?	------
Western Triumph	m	ob ov	b	g	F M	M	Am.	------	------	*	*	------
Wilson	l	ob ov	b	v g	M	E	Am.	*	*?	*	*?	------
Wilson Junior	l	ob ov	b	v g	M	E	Am.	*	*?	*	*?	------

CHERRIES.

As noted in the accompanying bulletin by Pres. Lyon the sweet cherries are, as a rule, short-lived in Michigan, although the method of training and handling them that he recommends will undoubtedly prolong their life. Black Tartarian, Gov. Wood, Yellow Spanish and Napoleon easily stand at the head of the list. Windsor is highly commended in some places but seems to be lacking in hardiness in others. Among the varieties in the Duke and Morello class, Early Richmond, May Duke, Large Montmorency and Morello seem most generally successful, although Late Duke, Royal Duke and Olivet thrive wherever they have been grown.

In localities where hardiness is desirable the Wragg, Ostheim and Brusseler seem worthy of trial. The Vilne Sweet has fruited this year and seems to be the equal of the Gov. Wood in every respect and is said to be much superior in hardiness.

For the most part the cherry is troubled by the same insects and diseases as the plum and the treatment recommended in Bulletins 103 and 104 will be found useful.

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CHERRIES.

ABBREVIATIONS.—SIZE—l, large; m, medium; s, small. FORM—ob h, obtuse heart shape; r ob h, roundish obtuse heart shape; r h, roundish heart shape; r, roundish or round. COLOR—l r, lively bright red; d r, dark red, almost black; a m, amber mottled with red; y r, yellow ground shaded and marbled with red. USE—F, family, for dessert; F M, family or market; K M, for cooking or market; M, market. SEASON—E, early; M, medium; l, late. ORIGIN—F, foreign; Am., American.

Names.	Description.						Value.				
	Size.	Form.	Color.	Use.	Season.	Origin.	Southern Lake Shore.	Northern Lake Shore.	Southern Michigan.	Central Michigan.	Northern Michigan.
Heart and Bigarreau Cherries—											
Bigarreau, *Yellow Spanish*	l	ob h	y r	F M	M	F.	*	*	*	*	------
Black Eagle	l	ob h	d r	F M	M	F.	*?	*?	*?	*?	------
Black Heart	l	r h	d r	F M	M	F.	*?	*?	*?	*?	------
Black Tartarian	l	r h	d r	F M	M	F.	**	**	**	**	------
Downer Late	m	r h	y r	F M	L	Am.	*	------	------	*?	------
Early Purple	m	r h	d r	F M	E	F.	*	*?	*?	*	------
Elton	l	r h	y r	F M	M	F.	*	*	*?	*?	------
Governor Wood	l	r h	y r	F M	M	Am.	**	**	**	**	------
Napoleon	l	r ob h	y r	F M	M	F.	*	*	*	*	------
Rockport	l	r ob h	a m	F M	E	Am.	*	*?	*?	*	------
Windsor	l	r h	d r	M	L	Am.	†	†	†	------	------
Duke and Morello Cherries—											
Carnation	m	r	a m	K M	L	F.	*?	------	*?	†	------
Early Richmond	s	r	l r	K M	E	F.	**	**	**	**	**
Eugenie *Empress Eugenie*	m	r ob h	d r	F M	M	F.	*	------	*?	*	------
Hortense	l	r	l r	F M	L	F.	*?	*	*?	*	------
Late Duke	l	ob h	d r	K M	L	------	*	*	*	*	------
Late Kentish	m	r	r	K	M	F.	*	------	*?	**	------
Louis Phillippe	l	r	d r	K M	L	F.	*	*?	------	*	------
Magnifique	l	r h	l r	K M	L	F.	*	*	*?	*	------
May Duke	l	r ob h	d r	K M	E	F.	**	**	**	**	*
Montmorency, Large	l	r	d r	K M	M	F.	**	*	*	**	------
Morello, *English Morello*	l	r h	d r	K M	L	F.	**	**	**	**	**
Olivet	l	r	r	F	M	F.	------	*?	*?	*	------
Royal Duke	l	r	d r	K M	M	F.	*	*	*	*	------

CURRANTS.

The notes upon these fruits in the South Haven report are very complete and little more need be said. Although the Cherry, Fay and Versaillaise produce much larger fruit than the Red Dutch, Victoria and Prince Albert, they are so infested with borers that the latter will be found much more reliable. The Prince Albert in particular should be commended as it is but little troubled by currant worms, and carries its fruit until all other varieties are gone.

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CURRANTS.

ABBREVIATIONS.—SIZE—l, large; m, medium; s, small. FORM—with reference to form of bunch—l, long; v l, very long; s, short; m, medium. COLOR—r, red; b, black; w, white. QUALITY—a, acid; m a, moderately acid; v a, very acid. USE—K M, kitchen and market; F M, family and market; M, market. SEASON—E, early; M, medium; L, late. ORIGIN—Am, American; F, foreign.

Names.	Description.							Value.				
	Size.	Form.	Color.	Quality.	Use.	Season.	Origin.	Southern Lake Shore.	Norther Lake Shore.	Southern Michigan.	Central Michigan.	Northern Michigan.
Black Naples	l	s	b	m a	K M	M	F.	*	*	*	*	*
Cherry	l	s	r	v a	M	M	F.	*	*	*	*	*
Fay	l	l	r	m a	F M	M	Am.	*	*	*	*	*
Lee	l	l	b	m a	F M	M	F.	*	*	*	*	*
Prince Albert	l	l	r	m a	M	L	F.	*	*	*	*	*
Red Dutch	m	m	r	m a	F M	E	F.	**	**	**	**	**
Versaillaise	l	s	r	a	M	M	F.	*	*	*	*	*
Victoria, *Raby Castle*	l	v l	r	a	F M	L	F.	**	**	**	**	**
White Dutch	m	l	w	m a	F M	E	F.	**	**	**	**	**
White Grape	m	l	w	m a	F M	E	F.	*	*	*	*	*

GOOSEBERRIES.

The Downing is as yet the variety for market, although Smith, Houghton and Pale Red are largely grown. The Industry has been extensively advertised and quite generally planted, but except in a very few localities it has been a failure. The plant is a poor grower except in cool, moist soils, and the leaves and fruits are much injured by mildew. The use of fungicides will suffice to hold this disease in check. Red Jacket is the most promising of the new sorts.

GOOSEBERRIES.

ABBREVIATIONS.—SIZE—l, large; m, medium; s, small. FORM—r, round; o, oval; r o, roundish oval. COLOR—r, reddish, when fully ripe; g, greenish yellow, when fully ripe. QUALITY—g, good; v g, very good; b, best. USE—K, Kitchen; M, market. SEASON—E, early; M, medium; M L, medium late. ORIGIN—Am, American; F, Foreign.

Names.	Description.							Value.				
	Size.	Form.	Color.	Quality.	Use.	Season.	Origin.	Southern Lake Shore.	Northern Lake Shore.	Southern Michigan.	Central Michigan.	Northern Michigan.
Downing	m	r o	g	v g	K	M L	Am.	**	**	**	**	**
Houghton	s	r o	r	g	K M	E	Am.	*	*	*	*	*
Industry	l	r o	r	v g	K	M	F.	*?	*?	*?	*?	*?
Smith, *Smith's Improved*	l	o	g	v g	K M	M	Am.	*	*	*	*	*

GRAPES.

Not less than fifty varieties of this fruit are brought out each year, and the list has become so loaded down that many of the best varieties are buried out of sight. Worden and Concord are still our best black grapes

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and Delaware leads the list of the reds, followed closely by Salem, one of the Rogers' hybrids. In some sections, however, the Brighton is preferable to either of these sorts, but, in many localities, it is so subject to mildew that it is not held in high esteem. Of the white varieties, the Niagara stands at the head of the list. Although not universally successful, it is very productive in the grape-growing districts, and the large size of the bunches and the quality of the fruit make it readily salable at a remunerative price. Winchell (Green Mountain) of the new grapes is certainly an acquisition as an early white variety, while Colerain is very promising.

GRAPES.

ABBREVIATIONS.—SIZE—with reference to the berry; l, large; m, medium; s, small. FORM—with reference to the bunch and berry; s r, short bunch, round berry; l r, large and round; m r o, medium bunch, roundish oval berry; m r, medium bunch, round berry. COLOR—b, black, or nearly so when fully ripe; r, reddish or copper-brownish red; g, greenish white or yellowish. QUALITY—g, good; v g, very good; b, best. USE—T, table; M, market; W, wine. SEASON—E, early; M, medium; L, late. ORIGIN—The species to which each variety belongs is designed as follows: Lab., *Labrusca*; Æst., *æstivalis*; Rip., *riparia*; Vulp., *vulpina*. An x after one of the species denotes a cross with a variety of some other species. Hyb., hybrid, between a foreign variety and one of the native species.

Names.	Description.							Value.				
	Size.	Form.	Color.	Quality.	Use.	Season.	Origin.	Southern Lake Shore.	Northern Lake Shore.	Southern Michigan.	Central Michigan.	Northern Michigan.
Agawam	l	s r o	r	g	T M	M	Hyb.	*	*	*	*	------
Barry	l	r	b	g	T M	M	Hyb.	*	------	------	*	------
Brighton	l	r	d p	v g	T	E	Hyb.	*	*	**	**	------
Catawba	l	m r o	r	b	T M W	L	Lab.	*?	*?	*?	*?	------
Concord	l	l r	b	g	T M W	M	Lab.	**	**	**	**	**
Delaware		s r	r	b	T M W	M	x?	**	**	**	**	**
Diana	m	s r o	r	v g	T M	L	Lab.	*	*?	*?	*?	------
Empire State	s	r	w	v g	T M	M	Hyb.	*	*?	*	*	------
Eumelan	m	r	b	v g	T	M	Lab.	*?	*?	*?	*?	------
Goethe	l	l r o	g	v g	T W	L	Hyb.	*?	------	*?	------	------
Hartford (*Prolific*)	l	m r o	b	g	M	E	Lab.	*?	*?	*?	*?	*
Hayes	m	s r	w	v g	T	M	Lab.	*?	------	------	------	------
Herbert	l	l r	b	v g	T M	M	Hyb.	*?	------	*?	*?	------
Iona	m	m r o	r	b	T M W	L	Lab.	*?	------	*?	*?	------
Ives	m	m r o	b	g	M W	M	Lab.	*?	*?	------	*?	------
Jefferson	m	m r	r	v g	T M	M	Hyb.	*?	------	*?	*?	------
Lady	l	r	w	g	T M	E	Lab.	*	------	*	*	------
Lindley	m	m r o	r	g	T M	M	Hyb.	**	*	*	*	------
Massasoit		m r	r	g	T M	M	Hyb.	*	*?	------	*	------
Merrimac		s r	b	g	M	M	Hyb.	*	------	*	------	------
Moore Early	l	r	b	g	T M	V E	Lab.	*	*	**	**	**
Niagara	l	r	w	g	T M	M	Lab.	**	*	**	**	**
Pocklington	l	l r	w	g	T M	M	Lab.	*	------	*	*	------
Prentiss	m	m r	w	v g	T M	M	Lab.	*	------	------	*	------
Salem	l	r	b	g	M	M	Hyb.	**	*	**	**	------
Vergennes	s	l r	p	v g	T M	E	Lab.	*	*	*	*	------
Wilder	l	l r	b	v g	T M	M	Hyb.	*	*?	*?	*	------
Worden	l	r	b	g	T M	E	Lab.	**	**	**	**	**
Woodruff	l	m r	r	g	M	M	Hyb.	*	------	*	*	------
Wyoming	m	m r	r	g	M	M	Lab.	*	------	*	*	------

While the above varieties are sufficient to cover the season of ripening and embrace the leading commercial sorts, some growers may wish for a somewhat longer list, and for them the following additional kinds would be desirable: Agawam, Barry, Empire State, Lady, Lindley, Massasoit,

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Merrimac, Moore Early, Pocklington, Vergennes, Wilder, Woodruff and Wyoming. Hartford and Ives are sometimes of value. The other varieties in the list have been given *? in nearly every section and, while several of them, as Catawba, are among our best grapes where they thrive, they succeed in very few sections of Michigan. For notes upon these and many other sorts, reference is given to our South Haven Bulletin.

PEACHES.

In the peach list, the varieties with two stars will make up a good collection for market purposes and the addition of a few sorts of rather higher flavor from the single star group, such as Mountain Rose and Oldmixon, will give one as good as can be selected for home use. As this fruit has been treated at length in Bulletins 103 and 104 nothing more need be said here.

PEACHES.

ABBREVIATIONS.—SIZE—l, large; m, medium; s, small. CLASS—F, freestone; C, clingstone. COLOR—relative to the flesh, w, white or pale color; y, yellow or yellowish; g, greenish white, red at stone. QUALITY—j v, juicy vinous; m j r, melting, juicy, rich; s j, sweet, juicy; s j h, sweet, juicy and high flavored. GLANDS—s, serrated, without glands; g, glands, globose; r, glands, reniform. SEASON—E, early; M, medium; L, late; V E, very early; V L, very late. ORIGIN—Am, American; F, foreign.

Names.	Description.							Value.			
	Size.	Class.	Color.	Quality.	Glands.	Season.	Origin.	Southern Lake Shore.	Northern Lake Shore.	Southern Michigan.	Central Michigan.
Alexander	m	F	w	s j	g	V E	Am.	*?	*	*	*
Barnard	m	F	y	j v	g	E	.....	**	**	**	**
Beer Smock	l	F	y	j v	.....	L	Am.	*	*	*	*
Bronson	m	F	y	j v	.....	L	Am.	**	**	**	**
Crawford Early	l	F	y	j v	g	M	Am.	*	*?	*	*
Crawford Late	l	F	y	j v	g	L	Am.	*	*?	*	*
Early Michigan	m	F	w r	j v	.....	E	Am.	**	**	**	**
Elberta	l	F	y	m j r	.....	M	Am.	*	*	*	*
Engle Mammoth	l	F	y	m j	g	M	Am.	**	**	**	**
Foster	l	F	y	j v	g	L	Am.	*	*?	*?	*?
George IV	m	F	y	m j r	g	M	Am.	*?	.....	*?	*?
Gold Drop	m	F	y	j v	r	V L	Am.	**	**	**	**
Hale	m	F	w	m j r	g	V E	Am.	**	**	**	**
Hill's Chili	m	F	y	j r	.....	L	Am.	**	*	**	**
Kalamazoo	m	F	y	m j r	.....	L	Am/	**	**	**	**
Large Barnard	l	F	y r	j r	.....	M	Am.	*	**	*	*
Large Early York	m	F	w	s j h	g	V E	Am.	*	*	*	*
Lewis	m	F	w	m j r	g	E	Am.	**	**	**	**
Mountain Rose	m	F	w	s j	g	M	Am.	*	*	*	*
Oldmixon Free	l	F	g	s j h	g	M	Am.	*	**	**	**
Oldmixon Cling	l	C	w	m j r	g	M	Am.	*	*	*	*
Red Cheek Melocoton	l	F	y	j v	g	M	Am.	*	*	*	*
Richmond	m	F	w	m j	r	M	Am.	*	*	*	*
Rivers (*Early Rivers*)	l	F	p y	m r	r	E	Eng.	*	*	*	*
Saint John	l	F	y	s j	g	V E	Am.	*	*	*	*
Salway	l	F	y r	m j	r	M	Am.	*	*?	*	*?
Smock	l	F	y	j v	r	L	Am.	**	**	**	**
Snow's Orange	m	F	y	m j	r	M	Am.	**	**	**	**
Stump the World	l	F	w	s j h	g	L	Am.	*	*	**	**
Susquehanna	l	F	y	s j v	g	M	Am.	*	.....	*?	*?
Yellow Bareripe	l	F	y	j v	g	E	Am.	*	*	*	*

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PEARS.

While many commercial pear growers make a specialty of some one variety that seems particularly suited to their soil or method of handling it, others select such sorts as will give them a succession throughout the season and as a rule they will be about the same as would be planted for family use. Pear trees are known as standards or dwarfs, the difference being due to the kind of roots upon which they have been worked; in one case they are budded upon seedling pear stocks while, in the other, quince stocks have been used. Dwarfs are seldom used in commercial orchards although if the branches are cut in annually, so that they will correspond with the area of the roots, and the trees are given plenty of plant food and thorough cultivation they will be found quite profitable.

Reference to the "value" column of the pear list will show that the Bartlett and Anjou stand high in the estimation of fruit growers, both of them receiving double stars in every section of the state. The first is a well-known sort that succeeds everywhere but the other is not so well-known. It grows and fruits well, both as a standard and a dwarf, and is one of the most valuable sorts both for home use and market.

The varieties that come next in general favor are Bosc, Clapp Favorite, Flemish Beauty, Howell, Seckel and Sheldon. The Bosc stands very close to the Anjou as a variety for either home use or market; coming between that variety and Bartlett it is well worthy of a place upon every list. Clapp Favorite is liable to rot at the core unless it is picked early and ripened in a warm room; while a productive variety, it is not as valuable as the kinds above mentioned, and although a few trees may be desirable it is not worthy of extensive planting. Flemish Beauty succeeds well in some localities and contests with the Bartlett for supremacy in its season. In other sections it is so subject to scab and cracking that it is not appreciated. With a proper use of Bordeaux mixture, fairly good results can be obtained with this sort in nearly all localities.

The Howell is one of the most desirable of autumn pears for market, in particular, and is worthy of a place upon the list for home use. The Seckel and Sheldon are well known and valuable varieties, but they require (the Seckel particularly) thorough cultivation and high manuring if large, perfect fruits are to be obtained. Onondaga in some respects resembles Bartlett, but it is later and a good market sort. Lawrence follows Anjou and is excellent for early winter use.

Of the varieties particularly desirable for market sorts are Keiffer and Clairgeau. In the southern part of the state these vatieties, when well ripened, have a ready sale for cooking purposes and have been found quite profitable.

The Angouleme (Duchess) has quite generally been given two stars and when grown as a dwarf it is certainly worth planting as the fruit is large, of fair quality, and produces in abundance. The Louise Bonne is another sort that should always be grown as a dwarf, while Anjou, Bosc, Howell and Seckel do well that way.

Of the other varieties that are worth a place in the list, Boussock, Buffum, Josephine of Malines, Lawrence, Lucrative, Madeleine, Onondaga, Osband, Sterling, Stevens Genesee, Sumner Doyenne, Tyson, Vicar and Winter Nelis are most valuable. As a list that gives a succession through the season the following is submitted: Sumner Doyenne, Sterling, Clapp

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Favorite, Bartlett, Howell, Onondaga, Bosc, Sheldon, Anjou and Lawrence.

Of the varieties of pears recently placed upon the market, the best known are Idaho, Wilder and Vermont Beauty. While they have not been sufficiently tested in Michigan to warrant an opinion of their value, it may be well to state that the Idaho is almost identical with Sheldon, while the other two resemble Seckel, the former being earlier and the latter later than that variety.

PEARS.

ABBREVIATIONS.—SIZE—s, small; l, large; m, medium. FORM—p, pyriform; r o p, roundish obtuse pyriform; r a p, roundish acute pyriform; ob p, obtuse pyriform; ob o p, oblong obtuse pyriform; r, roundish; r ob, roundish obtuse. COLOR—y g, yellow or yellowish green with a red or russet red cheek; y r, yellow and russet; y, when mostly yellow or yellowish. QUALITY—g, good; v g, very good; b, best. USE—F, valuable family dessert; K M, kitchen and market; F M, family and market. SEASON—S, summer; L S, late summer; A, autumn; E A, early autumn; L A, late autumn; W, Winter. ORIGIN—Eng., English; Am., American; F, French; Fl, Flemish; B, Belgium; H, Holland.

Names.	Description.							Value.				
	Size.	Form.	Color.	Quality.	Use.	Season.	Origin.	Southern Lake Shore.	Northern Lake Shore.	Southern Michigan.	Central Michigan.	Northern Michigan.
Angouleme (*Duchess*)	l	ob o p	y	v g	F M	A	F.	**	*	**	**	**
Anjou, *Buerre d' Anjou*	l	ob p	y g	v g	F M	L A	F.	**	**	**	**	**
Bartlett	l	ob o p	y	v g	F M	L S	Eng.	**	**	**	**	**
Bloodgood	m	r	y r	v g	F	S	Am.	*	*?	*?	*?	
Bosc, *Beurre Bosc*	l	p	y r	b	F M	L A	B.	*	*	**	**	
Bousseock	l	r o p	y r	v g	F M	E A	B.	*	*	*	*	
Brandywine	m	r ob	y g	v g	F M	S	Am.	*?			*	*
Buffum	m	r o p	y g	g	M	E A	Am.	*	*	*	*	
Clairgeau	l	p	y r	g	M	L A	F.	*	*	*	**	*
Clapp Favorite	l	ob o p	y g	v g	F M	S	Am.	*	*	*	**	**
Dana Hovey	s	r ob p	y g	b	F	W	Am.	*		*		
Diel	l	r ob p	y r	v g	F M	L A	B.	*			*?	
Easter Beurre	l	r ob p	y r	v g	F	W	B.	*?			*	
Flemish Beauty	m	r ob p	y g	v g	F M	E A	B.	*	*	**	**	*
Giffard	l	p	y g	v g	F M	S	F.	*?		*?	*?	
Glout Morceau	l	ob p	y	g	F	L A	F.			*?	*?	
Gray Doyenne	m	r	y r	b	F M	L A	F.			*?	*?	
Hardy, *Beurre Hardy*	l	ob p	y g	v g	F M	E A		*?	*?	*?	*?	
Howell	l	r p	y g	v g	F M	E A	Am.	*	*	*	*	
Josephine of Malines	m	r ob p	y r	v g	F M	W	F.	*	*	*	*	
Kieffer	l	r o p	y r	g	K M	A	Am.	*	*	*	*	
Lawrence	m	r o p	y r	v g	F M	W	Am.	*	*	*	*	
Louise Bonne of Jersey	l	ob p	y g	v g	F M	E A	F.	*	*	*	*	*
Lucrative	m	ob r	g y	b	F	E A	Fl.	*	*	*	*	
Madeline	m	p	y g	v g	F M	S	F.	*		*	*	
Manning Elizabeth	s	ob p	y r	v g	F	S		*?		*?	*?	
Mount Vernon	m	r o p	y r	v g	F M	L A	Am.	*?	*?	*?	*?	
Onondaga, *Swan's Orange*	l	ob p	y g	v g	F M	L A	Am.	*	*	*	*	
Osband Summer	s	r p	y g	v g	F	S	Am.	*	*	*	*	
Pound	l	p	y	g	K M	W					*	*
Rostiezer	s	p	y g	b	F	S		*?	*?	*?	*?	
Seckel	s	r	y g	b	F M	A	Am.	*	*	**	**	*
Sheldon	m	r	y g	v g	F M	A	Am.	*	*	**	**	*
Souvenir du Congress	l	p y r	y g	v g	F M	S	F.			*	*	
Sterling	m	r	y g	v g	F M	E A	Am.	*	*	*	*	
Stevens Genesee	l	r	y	v g	F M	E A	Am.	*	*	*	*	
Summer Doyenne	s	r o p	y g	v g	F	S	B.	*	*	*	*	*
Superfin, *Beurre Superfin*	m	r p	y r	v g	F	A	F.		*?	*?	*?	
Tyson	m	r a p	y g	b	F	S	Am.	*	*?	*	*	
Vicar, *Vicar of Winkfield*	l	p	y	g	K M	W	F.	*	*	*	*	
White Doyenne, *Virgalieu*	m	ob p	y g	b	F M	A	F.	*?	*?	*?	*?	*
Winter Nelis	m	ob p	y r	b	F M	W	B.	*	*	*	*	*

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PLUMS.

ABBREVIATIONS.—SIZE—l, large; m, medium; s, small. FORM—o, oval; ob, obovate; r, roundish. COLOR—g, greenish; p, purplish; r, reddish; y, yellow. QUALITY—b, best; g, good; v, very. USE—F, family; M, market. SEASON—E, early; L, Late; M, medium. ORIGIN—Am, American; F, Foreign.

Names.	Description.							Value.				
	Size.	Form.	Color.	Quality.	Use.	Season.	Origin.	Southern Lake Shore.	Northern Lake Shore.	Southern Michigan.	Central Michigan.	Northern Michigan.
European—												
Bavay, *Bavay's Green Gage.*	l	r	g y	b	F	L	F.	*	*	*	*	------
Bradshaw	l	o ob	r p	g	M	M	Am.	**	**	**	**	**
Coe Golden Drop	l	o	y r	v g	F M	L	F.	**	**	**	**	**
Field	l	r o	r p	g	M	E	Am.	†	†	†	†	------
Copper	m	o	p	g	F M	M	F.	†	†	†	†	------
Damson	s	o	p	g	M	L	Am.	*	**	*	*	*
Duane Purple	l	o	r p	g	F M	E	Am.	*	*	*	*	------
German Prune	l	o	p	g	F M	M	F.	*	*	**	*	*
Grand Duke	l	r o	p	v g	F M	L	F.	†	†	†	†	------
Green Gage	s	r	g y.	b	F	M	F.	*	*?	*	*	*
Imperial Gage	m	o	g y	b	F M	M	Am.	*	*	*	*	------
Italian Prune, *Fellemburg*	m	o	p	g	F M	M	F.	*	*	*	*	------
Jefferson	l	o	y r	b	F M	M	Am.	*?	*?	*?	*?	------
Lombard	m	r o	r p	g	M	M	Am.	**	**	**	**	**
MacLaughlin	l	r	y r	b	F M	M	Am.	*	------	*	------	------
Moore Arctic	m	r o	p	g	F M	M	Am.	------	*	*?	*	*
Pond (English)	l	o	y r	g	M	M	F.	*	**	**	**	**
Prince Englebert	l	o	p	v g	F M	M	F.	------	**	*	**	*
Quackenboss	l	r	p	g	M	M	Am.	*	**	*	**	*
Shropshire Damson	s	o	p	g	F M	L	Eng.	*	**	**	*	**
Smith Orleans	l	o	r p	v g	F M	M	Am.	*	*	*	*	------
Stanton	m	r o	d p	v g	F M	L	Am.	†	†	†	†	------
Washington	l	r o	g y	v g	F M	M	Am.	*	*	*	**	**
Yellow Egg	l	o	y	g	F M	M	------	*	*	*	*	*
Japanese—												
Abundance (*Sweet Botan*)	m	r o	p	g	F M	M	Jap.	*	*	*	*	*
Botan (*White*)	m	r o	r p	g	F M	M	Jap.	------	*?	*?	*?	------
Burbank	m	r	p	g	F M	M	Jap.	†	†	†	†	------

For extended notes upon the varieties of plums reference is made to Bulletin 103.

QUINCES.

ABBREVIATIONS.—SIZE—l, large; m, medium; s, small; v, very. FORM—o, oblate; ob, obtuse; p, pyriform; r, roundish. COLOR—g, greenish; y, yellow. QUALITY—H, half tender; T, tender. USE—F, kitchen; M, market. SEASON—E, early; L, late. ORIGIN—Am, American; F, foreign.

Names.	Description.							Value.				
	Size.	Form.	Color.	Quality.	Use.	Season.	Origin.	Southern Lake Shore.	Northern Lake Shore.	Southern Michigan.	Central Michigan.	Northern Michigan.
Apple or Orange	l	r	y	h t	M K	E L	------	**	*	**	**	------
Champion	v l	ob p	y	t	M K	L	Am.	*	*	*	*?	------
Meech	l	rob	y	t	M K	M	Am.	†	†	†	†	------
Rea	l	rob	y	h t	M K	E	Am.	------	*	*	*	------

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RASPBERRIES.

The varieties of Sub-section 1 are not used for market purposes, but on account of their superior flavor they are valued for home consumption in the southern part of the State.

Of those in Sub-section 2, Shaffer seems to be the only one that is favored. The berries are large and are produced abundantly, but their dull color and peculiar flavor are against them. In Sub-section 3, Palmer seems to be the favorite for early, and Gregg for late, although Conrath, Ohio and Souhegan had many votes. The Hansell and Marlboro seem to be well liked as early red sorts, and Cuthbert is universally favored for late. Turner is liked in the northern section because of its superior hardiness. Crimson Beauty seems also to succeed in some localities if planted with other kinds that can fertilize it.

RASPBERRIES.

ABBREVIATIONS.—SIZE—l, large; m, medium; s, small; v, very. FORM—c, conical; o, obtuse; r, roundish. COLOR—b, black; p, purplish; r, reddish; y, yellow. QUALITY—b, best; g, good; v, very. USE—M, market; F, family. SEASON—E, early; L, late; M, medium. ORIGIN—Am, American; F, foreign.

Names.	Description.							Value.				
	Size.	Form.	Color.	Quality.	Use.	Season.	Origin.	Southern Lake Shore.	Northern Lake Shore.	Southern Michigan.	Central Michigan.	Northern Michigan.
Sub-section 1.—R. Idaeus—												
Clarke	m	r	r	g	F M	E	Am.	*	*?	*?	-----	-----
Herstine	l	ob c	r	v g	F M	M	Am.	*	-----	*?	*?	-----
Hudson River Antwerp	l	c	r	b	F M	M	Am.	*	-----	*?	*?	-----
Orange, *Brinckles*	l	c	y	b	F	M	Am.	*	-----	*?	*?	-----
Sub-section 2.—R. neglectus—												
Caroline	m	ro	y	g	F	M	Am.	*		*	*	
Philadelphia	m	r	p	g	M	M	Am.	*	-----	*	*	-----
Purple Cane	m	r	p	g	M	M	Am.	*?	-----	*	*	-----
Shaffer	v l	r	p	g	F M	M	Am.	**	**	**	**	*
Sub-section 3.—R. occidentalis—												
Conrath	m	r	b	g	F M	E	Am.	*	*	**	**	-----
Doolittle	s	r	b	g	M	M	Am.	*	*	*		-----
Gregg	v l	r	b	g	F M	M	Am.	**	**	**	**	*
Hilborn	v l	r	b	g	F M	M	Am.	*	*	*?	*	
Johnston Sweet	m	r	b	v g	F M	M	Am.	*	*	*?	*	-----
MacCormick, *Mam. Cluster*	m	ob c	b	v g	F M	L	Am.	*	*	*	*	-----
Nemaha	l	r	b	g	F M	M	Am.	*	*	*	*	*
Ohio	m	r	b	g	F M	M	Am.	*	*	**	**	*
Palmer	m	r	b	g	F M	E	Am.	**	**	**	**	*
Souhegan, *Tyler*	m	r	b	g	F	E	Am.	*	*	*	*	*
Sub-section 4.—R. strigosus—												
Brandywine	m	r c	r	g	F M	M	Am.	*		*		
Cuthbert	l	r o	r	g	F M	M	Am.	**	**	**	**	**
Golden Queen	l	r c	y	v g	F M	M	Am.	*	*	*	*	
Hansell	m	r c	r	v g	F M	V E	Am.	*		*	*	-----
Marlboro	l	r c	r	g	F M	M	Am.	*	*	*?	*	*
Turner	m	r	r	g	F M	E	Am.	*	-----	*	**	*

STRAWBERRIES.

The new strawberries do not seem to have met with much favor, as there were very few votes for kinds that have been introduced less than ten years. In addition to those mentioned in the list there were a few votes for Enhance, Greenville, Beverly, Marshall, Shuckless and Timbrell, but

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it is not likely that the last three had been thoroughly tested. All of them are probably valuable sorts, if we can judge from their behavior elsewhere.

For notes upon other new sorts of raspberries and strawberries, the reader is referred to Bulletins 104 and 106.

STRAWBERRIES.

ABBREVIATIONS.—SIZE—l, large; s, small; m, medium. SEX—B, bisexual; P, pistillate; P B, nearly pestillate. COLOR—d c, deep crimson; d s, deep scarlet; b. s, bright scarlet; w t, whitish tinted with red; l c; light crimson. FORM—r c, roundish conical; o c, obtuse conical or coxcomb form; c, conical; r, roundish; r o c, roundish obtuse conical. FLESH—s, soft; f, firm; m, medium. SEASON—Early; M, medium-L, late; E L, early to late. ORIGIN—Am, American; F, foreign.

Names.	Description.							Value.				
	Size.	Sex.	Color.	Form.	Flesh.	Season.	Origin.	Southern Lake Shore.	Northern Lake Shore.	Southern Michigan.	Central Michigan.	Northern Michigan.
Bidwell	v l	B	b s	c	f	M	Am.	*	------	*?	*?	------
Bubach No. 5	l	P	d r	r c	m	M	Am.	**	*	**	**	**
Captain Jack	l	B	d r	r c	f	L	Am.	------	------	*	*	------
Charles Downing	l	B	d s	c	f	M	Am.	*?	------	------	*?	*?
Crawford	l	B	b c	o c	m	M	O.	*	------	------	*	------
Crescent	l	P	b s	r c	m	M	Am.	**	*	**	**	**
Cumberland	l	B	b s	r c	s	M	Am.	*	**	*	**	*
Eureka	l	P	b r	r	m	M	O.	*	*?	*	*	*
Gandy	m	B	b r	c	f	L	Am.	*?	*	*	**	**
Haverland	l	P	r s c	o c	m	M	Am.	**	*	*	**	**
Jersey Queen	v l	P	b s	r c	f	L	Am.	*?	*?	*?	*?	------
Jessie	v l	B	b s	r c	m	M	Am.	*	*?	*?	*?	*
Kentucky	l	B	b s	r c	f	L	Am.	*	*?	*?	*	------
Manchester	l	P	s	o c	f	M	Am.	*?	*	*?	*	*
Miner	v l	B	c	r c	m	M	Am.	*	*	*	**	*
Mount Vernon	l	B	l s	r o c	m	L	Am.	*	*	*	*	*
Mrs. Cleveland	l	P	b c	r c	m	M	O.	*	*	*	*	*
Parker Earle	l	B	b r	l c	f	M	Tex.	**	**	*	**	*
Pearl	m	B	b r	o c	f	M	Am.	*	*	*	*	------
Sharpless	v l	B	b r	o c	f	M	Am.	*	*	*	**	*
Warfield	m	P	d r	c	f	M	Ill.	**	*	**	**	*
Wilson	l	B	d c	r c	f	E M	Am.	**	**	**	**	*

In the above lists, the data regarding the size, shape, color, season and quality of the different varieties, etc., have been taken from the last report of the American Pomological Society, and the starring will be used in making up the Michigan Fruit List for the next volume, soon to be issued.

In the preparation of this catalogue, great assistance has been afforded me by the many persons who filled out and returned the circulars that were sent out. In most cases it was done so thoroughly and in such an intelligent manner that the returns were incorporated into this bulletin with a very few slight changes.

To all persons who aided in the preparation of this fruit list, the thanks of the collator are extended, for the help that was rendered and the many useful suggestions that were made.

While it is undoubtedly faulty in many particulars, it is sent out with the hope that it will be of value to prospective planters of fruit trees and plants.

AGRICULTURAL COLLEGE,
February 1, 1894.

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STRAWBERRIES AND RASPBERRIES.

BY L. R. TAFT AND H. P. GLADDEN.

Bulletin No. 106.—Horticultural Department.

The variety tests of the above fruits have been quite successful the past season, and we trust the results will be found useful. The soil upon which they have been grown is of a sandy nature, but it contains a considerable amount of clay; before the plants were set, it was well enriched with stable manure and the raspberries were mulched with that material the winter after setting. A mulch of straw and marsh hay was given the strawberries late in the fall of 1892 and, just as growth was starting in the spring, it was removed, to admit of the cultivating and loosening of the soil between the rows, and was then replaced to act as a mulch and keep the berries clean. The strawberries from which the notes were taken were set in the spring of 1892, although we had another plantation, of most of the older sorts made in 1891, which we used for comparison. The raspberries were for the most part set in 1890 and 1891; a few, however, of the newer sorts were not obtained until 1892.

The season was very favorable for the strawberry crop, although it was somewhat cut short by leaf blight and hot weather; the raspberries were considerably injured by the winter and the crop of berries was lessened by the hot, dry weather of July.

The data for the tables were obtained by, or under the direction of Mr. Gladden, and many of the notes were prepared by him.

STRAWBERRIES.

In August a bulletin was issued containing the notes on eighty new varieties, that fruited for the first time the past season. In the table below, the varieties marked with an asterisk (*), are those described in that bulletin, and any one wishing for a further description of those sorts, except the few that are here given, is referred to Bulletin No. 100.

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TABLE NO. 1.—STRAWBERRIES.

ABBREVIATIONS.

Form.
b, broad. l, long.
c, conical. o, oval.
d. depressed. r, round.
i, irregular.

Size.
s, small.
m, medium.
l, large.

Color.
b, bright. l, light.
c, crimson. r, red.
d, dark. s, scarlet.

Variety.	Sex.	Vigor (1-10).	Date of bloom.	First ripe fruits.	Last fruits.	Productiveness (1-10).	Size.	Form.	Color.	Quality.	Firmness.
*Accomack	b	6	May 24	June 21	June 30	6	m	l c	d c	9	7
*Afton	p	8	" 25	" 19	July 10	9.5	m to l	r c	d c	9	8.5
*Alabama	b	7	" 30	" 19	June 30	5	m	r c	d c	9	9.5
Alpha	b	6	" 25	" 21	July 5	8.5	m	c	l c	8	6
Arlington	p	8.5	" 24	" 16	" 10	9	m	r c	s	8	8
Auburn	p	9.8	" 29	" 21	" 10	8	m	o c	l c	9	8
Banquet	p	8	" 24	" 19	" 5	7	m	c	d c	9.5	6
*Beauty	b	8.5	" 24	" 21	" 10	9.5	l	r b c	b d s	8.5	6
Beder Wood	b	9	" 24	" 17	June 30	9	s to m	r	l c	7	8
Belle	b	8.5	" 25	" 23	July 9	9	m to l	l c	b s	8	9
*Belle of Lacrosse	p	8.5	" 25	" 21	" 9	9.5	l	r b c	b d s	8	8
*Beverly	b	9	" 25	" 21	" 10	8.5	l	r c	d c	9.5	9.5
*Bickle	p	8.5	" 24	" 19	----------	8.5	s to m	r c	l s	7	7
Boynton	p	9.5	" 24	" 19	July 5	9	s to m	o	l c	8	8
*Brunette	b	9	" 29	" 22	" 10	8	l	r c	v d c	9.5	9
Bubach	p	9.5	" 30	" 19	" 10	8.5	l	d c	l c	9	8
*California	b	7	" 29	" 26	" 10	4	s to m	l c	b d s	9.5	9
*Cameronian	b	9.5	" 29	" 25	" 8	8	m	r c	l s	7	7
*Cheyenne	p	8	" 25	" 21	" 10	7	m	l c	b s	9.8	9
*Clark Early	b	9.2	" 29	" 19	" 10	8.5	m to l	r c	d c	9.8	9
Clark Seedling	b	8.5	" 25	" 22	June 30	8	m to l	r c	d c	9.5	9
*Clyde	b	9.8	" 24	" 21	July 8	9.8	l to m	r c	b d s	8.5	9.2
Crawford	b	9	" 30	" 23	" 9	9	m	r c	s	9	9
Crescent	p	9.4	" 23	" 18	" 5	9.5	m	r c	s	7	8
Daisy	b	8.5	" 26	" 20	" 5	8.5	m	r c	l s	8	7
*Dayton	b	9	" 24	" 21	June 30	8	s	l c	------	9	8
Dew	b	9.4	" 31	" 26	July 6	7	l	i	d c	8	9
*Dutter	b	9	" 25	" 21	" 5	7.5	l	l c	b s	9	8.5
Eclipse	p	9.5	" 25	" 20	" 10	8.5	s to m	o	l c	8	8
Edgar Queen	b	9.2	" 25	" 21	" 10	9	m to l	i r c	l c	7	8
Enhance	b	9.5	" 24	" 21	" 9	9	m to l	i r c	d c	8	9.5
*E. P. Roe	b	6	" 24	" 26	" 7	5	l	b c	s	8.5	8
Eureka	p	9.3	" 27	" 23	" 5	8	m	r c	d c	7	8
*Fairmount	b	9	" 25	" 19	" 9	9.5	l	d c	d c	9	7.5
Gandy	b	9.5	" 31	" 26	" 10	8	m to l	r b c	l c	9	8
Gen. Putnam	p	9.5	" 24	" 17	" 6	9	m to l	r	l s	8	8
*Glenfield	b	9.2	" 24	" 21	" 10	5	m	l c	d c	9	7
Great Pacific	p	9.5	" 25	" 21	" 5	9.5	m	d c	r	9	8
*Greenville	p	9.2	" 29	" 22	" 10	9.5	l	r d c	b c	8	7
*Gypsy	p	9.3	" 24	" 21	" 10	9	m	r c	d c	9	9
*Harmon	b	9	" 24	" 19	June 30	4	l	r c	v d c	9	9
*Hattie Jones	p	9.4	" 26	" 21	July 8	9.5	m to l	r d c	l s c	6	7
Haverland	p	9	" 24	" 21	" 5	9	m	l c	s	8	8
*Hermit	b	9	" 24	" 21	" 10	8	l	r c	b c	8	8
Hoard	b	8.5	" 25	" 22	" 9	9	m to l	r c	l c	8	8
*Huntsman	p b	9.8	" 29	" 21	" 10	8.5	l	r c	d c	9	8
*Hyslop	b	8	" 25	" 21	June 29	------	s	i	------	------	------
*Iowa Beauty	b	8	" 25	" 21	July 5	7	l	r c	b c	10	8.5
Jessie	b	8.5	" 24	" 19	" 6	8	m to l	r c	d c	7	9
*Jones Seedling	b	8.8	" 25	" 21	" 7	8.5	l	d c	d c	9	8.5
*Katie	b	9.4	" 29	" 21	" 10	7	l	r d c	c	8.5	7.5
King No. 2	b	9	" 26	" 20	" 5	7	m	r c	l c	8	8
*Leader	b	8.6	" 24	" 21	" 9	8.5	l	l c	b d c	9.5	9
*Leroy	p	9.4	" 24	" 18	" 5	9	l	d c	d c	8.5	8
*Leviathan	b	7.5	" 28	" 21	" 10	8.5	l	b d	l s	6	5

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TABLE No. 1.—STRAWBERRIES.—CONTINUED.

Variety.	Sex.	Vigor (1-10).	Date of bloom.	First ripe fruits.	Last fruits.	Productiveness (1-10).	Size.	Form.	Color.	Quality.	Firmness.
Lida	p	7.5	May 25	June 21	July 10	9	m	r c	b c	7	8
*Lillie Monroe	b	8.5	" 25	" 19	" 10	5	l	d c	d s	8	7
*Lincoln	p	9	" 25	" 21	" 10	9	m	r d c	b s	7	8
Little No. 15	b	9	" 24	" 19	June 30	8.5	m	b c	c	9	8
Lovett	b	9	" 24	" 19	July 5	9	m	r c	b c	8	8
Lower	b	9.2	" 26	" 19	" 5	8	l	r c	d s	8	8
*Magnate	p	8.5	" 24	" 21	" 10	6	m	l c	b s	8	8.5
Michel	b	9.8	" 24	" 16	June 30	6	s	c	b s	7	7
Middlefield	b	8.5	" 20	" 21	July 8	7.5	m	c	c	9.5	9
Miner	b	9	" 26	" 19	" 6	8.5	m to l	c	d s	8	7
Moore Early	b	9	" 25	" 21	" 10	8	m to l	b c	b s	8	8
Mrs. Cleveland	p	9.8	" 25	" 19	" 10	9	m	r b c	b s	8	8
Muskingum	b	9.8	" 29	" 22	" 7	9	m to l	d c	d r	8.5	8
*Mystic	b	9.8	" 29	" 26	" 10	6	m to l	r c	b d c	9.5	9
*Neptune	p	9.8	" 29	" 21	" 9	6	m to l	r c	d c	7	5
*No. 1 (Allen)	p	8.5	" 29	" 22	" 5	9	m	r c	b c	9	9
*No. 8 (Allen)	b	9.5	" 31	" 26	" 8	7.5	l	r c	b c	8.5	7
*No. 3 (Belt)	b	9.2	" 25	" 26	" 10	9	l	c	b l s	8	8
*No. 2 (Cameron)	b	9.2	" 24	" 20	" 9	8.5	m	l c	b c	9	8
*No. 6 (Cameron)	p b	8.5	" 29	" 22	" 10	4	m	r b c	b s	8.5	8.5
*No. 13 (Cameron)	p	7.5	" 29	" 22	" 10	8	m	r c	b c	8	7.5
*No. 1 (Engle)	b	7	" 29	" 24	" 8	5	l	i r	l c	8	8
*No. 2 (Feicht)	b	9	" 25	" 18	" 10	9.5	m to l	r c	c	8	8.5
*No. 3 (Feicht)	p	7	" 25	" 20	" 10	8	l	i c	l c	7	9
*No. 31 (Haynes)	p	9.8	" 29	" 21	" 10	5	m	i r c	b s	6	6
*No. 2 (J. S.)	b	9	" 26	" 21	" 10	6	s to m	r c	c	8	8.5
*No. 4 (J. S.)	p	9	" 24	" 21	" 9	5	m	r c	v d c	9	7.5
*No. 6 (J. S.)	p	9	" 25	" 21	" 10	9.5	l	r c	b d s	7	6
*No. 18 (Little)	b	8	" 24	" 18	" 9	8.5	m	r c	b d c	8	8.5
*No. 26 (Little)	b	8.8	" 25	" 21	" 5	9	l	i	b d s	9	8
*No. 42 (Little)	b	8.5	" 24	" 21	" 10	9	l	r c	c	9	8
*No. 1 (Stayman)	p	9.5	" 29	" 22	" 6	9.5	m	r c	l s	8	8
*No. 3 (Stayman)	b	9.8	" 25	" 21	" 10	9.5	m	l c	d c	7	8.5
*No. 34 (Thompson)	p	8.8	" 25	" 22	" 8	5	m	r c	b c	8	8
*No. 77 (Thompson)	b	7.5	" 24	" 19	" 7	9.5	s	l c	b c	7	5
*Odessa	p	9	" 29	" 23	" 7	5	l	i	b s	7	7
Ohio Centennial	p	9.4	" 29	" 25	" 9	9	l	b c	d s	9	8.5
*Ohio Monarch	b	9.8	" 29	" 23	" 10	5	l	l c	b s	9	8
Ontario	b	8.4	" 29	" 26	" 8	9.4	m to l	c	l c	9	8.5
Parker Earle	b	9.6	" 29	" 25	" 10	9.8	m	c	d s	8.5	9.5
*Pawnee	b	9	" 24	" 19	" 9	7.5	l	r c	d c	9.8	7
*Primate	b	9.2	" 26	" 21	" 10	6	m	l c	d c	6	7
Princess	p	8.8	" 26	" 21	" 10	8	m to l	r	s	9	8
Sadie	p	9	" 24	" 19	June 30	9	m	r c	d c	9	8
Saunders	b	9	" 25	" 21	July 9	8	m to l	l c	b s	7	8
Sharpless	b	9.5	" 25	" 21	" 10	8	m	b c	b c	8	8
*Smeltzer Early	b	9.	" 25	" 21	" 8	8.5	m	r c	d c	9	8.5
*Southard	b	8.8	" 22	" 16	" 4	8	l	r c	b s	7	8
*Standard	b	9.5	" 25	" 24	" 7	9	l	r c	b d c	9.5	7
*Stevens	b	9.2	" 25	" 21	June 30	9	m	r c	d c	9	8
Stimmel No. 15	p	8	" 24	" 19	" 30	8.5	m	b c	l s	9	8
Stimmel No. 20	p	8	" 24	" 21	" 30	6	s to m	l c	d c	9	8
*Surprise	b	9.2	" 28	" 21	July 7	6	m	l c	b s	8	8
*Swindle	p	9	" 26	" 23	" 5	8	m	r c	c	7	9
*Tom Walker	p	9.8	" 26	" 19	" 9	9	l	r c	d c	8	8
Van Deman	b	7	" 25	" 19	" 9	5	m	r c	l c	8	8
Westbrook	p	8	" 25	" 21	" 8	8	m	c	d c	8	9
*West Lawn	p	8.5	" 25	" 21	June 30	6	s to m	i	d s	7	7.5
*Weston	p	9.5	" 29	" 21	July 9	9.8	l	b c	b s	8	8.5
*Williams	b	8.8	" 29	" 21	" 10	8.5	l	r c	d c	8.5	9
Wilson	b	8.5	" 28	" 21	" 10	8	m	c	d c	8	9
Woolverton	b	8.5	" 29	" 21	" 10	8.5	m	l c	d c	8	9
*Yankee Doodle	p	9.8	" 25	" 19	" 5	9	l to m	r d c	b s	8	9

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To test the comparative productiveness of a few of the leading varieties, the berries, upon rows eighteen rods in length, were picked and measured, and in the following table the crop obtained is given in quarts:

TABLE No. 2.—YIELD FROM ONE FORTY-FIFTH OF AN ACRE.

Variety.	Dates of picking.								
	June 20.	June 23.	June 24.	June 27.	June 29.	July 3.	July 5.	July 7.	Total quarts.
Bubach	5	10	7	13	8	14½	2½	¾	60¾
Haverland	3½	10	6	16	8	13	3	1	60½
Gandy	.....	3	.....	11	15	12	3	1½	40½
Lower	½	3	4½	12	11	9	2	1	43
Lida	1	2	4	4	14	5½	1	2	33½
Sucker State	1	.....	4	3	10	4	7	½	29½
Moore	.....	1½	3½	6	8	5	.....	¾	24¾

Most of the varieties were grown in narrow matted rows, with twenty-five plants in a space of forty feet.

At the time of blossoming, the plot containing the new varieties was carefully gone over, and the more promising sorts were marked, that their productiveness might be accurately determined. Some varieties that were very promising early in the season were disappointing at the close, hence the variableness of the yield. The same amount of space and equal care were given to each sort. By dividing the season into three periods and giving the yield for each division of time, an attempt has been made to show which are valuable as early varieties.

TABLE No. 3.—YIELD OF TWENTY-FIVE PLANTS IN QUARTS.

Variety.	June 21.	June 24.	June 26.	June 27.	Total yield, June 21-27.	June 28.	June 29.	June 30.	Total yield, June 28-30.	July 1.	July 3.	July 7-10.	Total yield, quarts.
Afton	1	4	1	.....	6	3	3	.....	4	2	½	½	13
Banquet	1¾	2	1½	1	6¼	.....	1½	¾	2¼	.....	¾	¾	9½
Beauty	1	2	2	.....	5	1¾	.....	1	2¾	1	½	¼	9½
Beverly	.....	2	1	.....	3	1	.....	4	5	.....	1½	3	12½
Brunette	½	1½	1	1	3½	.....	1¾	.....	1¾	.....	1	½	6¾
Greenville	.....	4	4	.....	8	2	.....	3	5	.....	3	¾	16¾
Gypsy	½	2½	2	.....	5	.....	.....	.....	0	2	¼	.....	7¼
Hattie Jones	1	2½	4	1	8½	.....	.....	4	4	.....	2½	1	16
Huntsman	¼	3	3½	½	7¼	.....	½	.....	½	.....	½	.....	8¼
Jones Seedling	4	2	1	.....	7	.....	.....	2	2	.....	2	½	11½
Katie	½	3	2	.....	5½	½	.....	½	1	.....	¼	½	7¼
Leader	1	2½	2	.....	5½	2½	.....	.....	2½	1½	¾	½	10¾
Leroy	.....	4	4½	1¼	9¾	.....	2	.....	2	.....	3¼	¼	15½
Leviathan	½	¾	2	.....	3¼	1¾	.....	1	2¾	.....	1½	¼	7¾
Lida	.....	2½	3½	.....	5¾	1	.....	.....	1	5	1½	1	14½
Lincoln	½	1½	2	.....	4	1¾	.....	1	2¾	.....	1½	¼	8½
Lovett Early	1	3	.....	6	10	.....	1½	.....	1½	.....	1¼	1½	14½
Mrs. Cleveland	1	4	4	.....	9	1½	.....	.....	1½	2	1	1	14½
Muskingum	.....	3	3	.....	6	.....	.....	.....	.....	3½	½	½	10½
Parker Earle	.....	½	1½	.....	2	4½	.....	6¼	10¾	2¾	.....	4½	20
Southard	1	2	2	1	6	.....	.....	½	½	.....	¼	.....	6¾
Standard	½	1	2½	½	4½	.....	.....	3	3	.....	1½	¼	9¼
Swindle	½	½	2	1	4	.....	1¾	.....	1¾	.....	2	¼	8
Tippecanoe	1	2	2	1¼	6¼	.....	1¼	.....	1¼	.....	2	½	10
Weston	½	2	3	.....	5½	1	.....	3¼	4¼	.....	4	½	14¼
Williams	.....	2	2	2	6	.....	.....	3	3	.....	1½	¼	10¾
Woolverton	.....	4	3½	.....	7½	.....	2	1	3	3	1½	2	16

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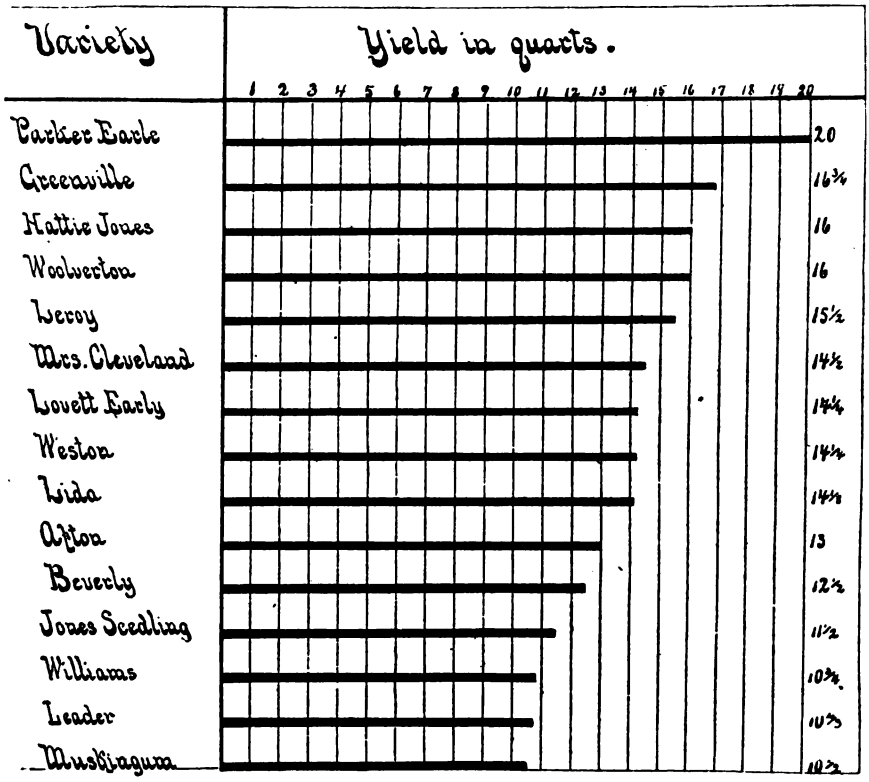
In the following diagram, we have endeavored to show at a glance the relative productiveness of the varieties in the above table, selecting only those with a yield in excess of ten quarts from the forty feet of row.

TABLE No. 4.—YIELD OF FIFTEEN SELECTED SORTS.



NOTES UPON VARIETIES.

We append brief notes upon the vigor, productiveness, quality and firmness of some of the more promising of the varieties of comparatively recent introduction, and refer the reader to the preceding tables for further information regarding the size, shape and color of their fruit and their date of ripening, etc.

Banquet still deserves a place as a home berry. It is handsome in appearance and of high quality, but is not productive enough for market purposes.

Beder Wood—In last year's report this variety, although quite vigorous and productive, was placed in the doubtful class from its low quality and lack of firmness. It is, however, the equal of Crescent in these respects and except that it is likely to be injured by the leaf blight it would probably surpass that sort in vigor of plant and productiveness. Since it can be kept free from this disease, at a slight cost, by the use of fungicides, there is a promising future before it.

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Belle should take a high place as a variety for market purposes, as it adds firmness to the other qualities desired in a profitable variety. The fruits are of good size, and are even in size, form and color.

Boynton is a promising sort, so far as the vigor and productiveness of the plants are concerned, but the berries are so small that it is not likely to become a profitable variety.

Edgar Queen is quite vigorous in plant and above the average in productiveness; the fruits often reach a large size and, although somewhat deficient in firmness and quality, it is likely to be desirable for local marketing.

Enhance has again shown itself one of the best varieties for either local market or shipping purposes. In vigor of plant and in firmness it stands near the head, while it is surpassed in fruit production by very few varieties.

Gandy is very vigorous in plant and is valued for its large, handsome fruit, its high quality and lateness in ripening, but it is rather below the standard of productiveness.

General Putnam has for four years been one of the most vigorous kinds grown and, although it does not stand particularly high in quality and firmness of fruit, it is surpassed by very few sorts in productiveness. The berries are from medium to large in size and quite regular in form. Worthy of trial.

Great Pacific, although in fruit of only medium size and moderate firmness, is so vigorous and productive that it is likely to be well worth planting as a variety for local market purposes.

Jessie and *Lida* require extra care to do well, and neither has been generally profitable, but the latter in particular has given us excellent results.

Loudon No. 15, now named Hoard, is a promising market sort. The plants are strong and productive, and the berries are above the average in size and firmness, and of very good quality.

Lovett is not as early as was claimed by its introducer, but it is vigorous, fairly healthy and quite productive, besides equaling, if not surpassing, the best of the old sorts in the quality and firmness of its fruit.

Michel (*Osceola*) is very vigorous in plant and is highly esteemed as a pollenizer and for early fruiting, since it furnishes a large amount of pollen and one or two pickings can be obtained from it before other varieties are ripe. While of little value as a market sort it can well have a small place in a family collection.

Mrs. Cleveland is one of the healthiest and most vigorous varieties grown. The plants are quite productive and the fruits make a fair showing in quality and firmness.

Muskingum has been grown by us for several years under the name of Kearns and, although somewhat troubled by rust, it is one of our best late varieties for sale in a local market. It is one of our most vigorous kinds, besides being quite productive, of good quality and fair firmness.

Ohio Centennial has for several years held a high rank for its vigor of growth, productiveness and excellent quality, as a variety for family or local market purposes, but it is rather deficient in firmness for a shipping variety.

Parker Earle is by many regarded as the most valuable of the comparatively new strawberries. It makes very few plants, but sets an immense

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number of fruits, and with high culture and a favorable season will ripen most of them.

Princess is hardly productive enough for a market berry, but its vigor and the high quality of its fruit give it a high rank among the varieties for a family collection.

Sadie is quite vigorous and productive; although of only medium size, its quality combined with its other good features makes it well worthy of trial, especially for home use.

Stayman No. 1 needs only a greater degree of firmness to be near the head of the list, as in vigor and productiveness it compares well with any sort grown the past year.

Stayman No. 3 has the vigor and productiveness of No. 1 and the fruit is fairly firm, but it lacks in flavor.

Swindle has qualities that would make it an excellent market sort were it not for the fact that it rusts so badly that it cannot be grown to advantage, unless it is sprayed. It is a seedling of Crescent and resembles that variety in the shape of its fruit. The berries, however, are firmer and of larger size.

Van Deman made a promising showing in 1890 but since that time it has been lacking in productiveness. As this is due to a large extent to the leaf blight, the variety should not be condemned.

Westbrook has thus far seemed rather deficient in productiveness, but its firmness and fair quality render it worthy of further trial as a shipping variety.

Woolverton which has somewhat disappointed us in past years, in vigor and productiveness, made an excellent showing this season and if it retains these characteristics will be a valuable shipping sort, owing to its more than usual firmness.

Although a full description of the varieties that have fruited but once upon our grounds was given in Bulletin 100, it seems desirable to repeat here the description given of the half dozen most promising sorts, viz.: Clyde, Greenville, Leroy, No. 2 (Feicht), Weston and Yankee Doodle.

Clyde. B.—Plants from Stayman & Black, Leavenworth, Kan. First received as Cycloma. The plants are of very strong growth; leaf-stalk long, slender; leaflets usually small, ovate; color, medium green; texture papery; teeth large, rounded. First ripe fruits June 21. Crop at best June 24-26. Fruit large to medium in size, round conical, or broad conical, dark scarlet color, flesh dark; productiveness 9.8, quality 8.5, firmness 9.2.

The plants remained healthy and crop held out well to close of season; they are productive and the berries are firm. One of the most promising of the new varieties for market purposes.

Greenville. P.—Plants from E. M. Buechly, Greenville, Ohio. Plants of strong growth; leaf-stalk usually long, quite stout, but reclining; leaflets usually large, round-ovate, turned up at edge, dark green, texture papery; teeth large, rounded. First ripe fruits June 21. Crop at best June 26-28. Fruit large, round conical or depressed conical, sometimes ridged; color, bright crimson; flesh dark; productiveness 9.5, quality 8, firmness 7.

The plants are strong growing, healthy and productive. The crop held out well to close of season. The fruit is lacking in firmness, otherwise excellent. A promising variety for use in a local market.

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Leroy. P.—Plants from J. H. Haynes, Delphi, Ind. Plants of strong growth; leaf-stalk of medium length, stout; leaflets medium size, narrow ovate, color dark green; texture papery; teeth large, pointed. First ripe fruits June 19. Crop at best June 24. Fruit large, depressed conical, sometimes ridged; color dark crimson; seeds prominent; flesh dark; productiveness 9, quality 8.5, firmness 8.

Plants are of vigorous growth and rust but little. The crop holds out well in size and productiveness. The fruit is not very firm but the seeds are prominent, making it a fairly good shipper. Early. Promising.

No. 2 (Feicht). B.—Plants from David Feicht, Little York, Ohio. Plants of strong growth, leaf-stalk usually long; leaflets of medium size, ovate; teeth sharp. First ripe fruits June 18. Crop at best June 24. Fruit medium to large in size; round conical; crimson color; flesh dark; productiveness 9.5, quality 8, firmness 8.5.

Plants strong and healthy. Crop ripened early and held out well. Its productiveness makes it promising for home use or local market.

Weston. P.—Plant of strong growth; leaf-stalk long; leaflets medium to large in size, broad ovate; color, dark green; texture, thin but tough. First ripe fruits June 21. Crop at best June 24-27. Fruit large, broad conical, somewhat ridged, bright scarlet color; flesh, medium dark; productiveness 9.8, quality 8, firmness 8.5.

Plants very strong and healthy. Crop held out best of any variety. Berry of attractive appearance and fair quality, seeds prominent, making it a good shipper. One of the best varieties grown here this season.

Yankee Doodle. P.—Plants from Geo. Q. Dow, North Epping, N. H. Plants of very strong growth; leaf-stalk varies in length; leaflets large, broad ovate; color, dark green; texture, tough. First ripe fruits June 21. Crop at best June 24. Fruit large to medium in size, round conical or depressed conical, bright scarlet color, flesh light; productiveness 9, quality 8, firmness 9. Now known as *Epping.*

Plants strong, healthy and productive. Crop held out fairly well. Promising as a market sort.

Closely following the above were the following varieties, some of which seem to have considerable value:

Afton.	Gypsy.	No. 3 (Stayman).
Beauty.	Huntsman.	Pawnee.
Belle of La Crosse.	Leader.	Smeltzer.
Beverly.	No. 1 (Allen).	Standard.
Brunette.	No. 2 (Cameron).	Stevens.
Clark (Early).	No. 26 (Little).	Tom Walker.
Fairmount.	No. 6 (J. S.).	Williams.

About forty varieties marked with asterisk (*) in Table No. 1 seemed to have some good points, but were so deficient in others that further trial will be needed to determine their value. The list includes:

Accomack.	Leviathan.	No. 4 (J. S.).
Alabama.	Lillie Monroe.	No. 34 (Thompson).
Bickle.	Lincoln.	No. 77 (Thompson).
Cameronian.	Jones.	No. 18 (Little).
Cheyenne.	Katie.	No. 42 (Little).
Clark (Seedling).	Magnate.	No. 2 (J. S.).

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Dutter.	Mystic.	Odessa.
Glenfield.	Neptune.	Ohio Monarch.
Harmon.	No. 3 (Allen).	Primate.
Hattie Jones.	No. 3 (Feicht).	Southard.
Hermit.	No. 6 (Cameron).	Surprise.
Iowa Beauty.	No. 13 (Cameron).	Westlawn.

Several varieties were so lacking in one or more of the characteristics of a good strawberry that they are placed in the following rejected list:

California.	E. P. Roe.	Nigger.
Dayton.	Estelle.	No. 1 (Engle).
Dr. Moraire.	Hyslop.	No. 31 (Haynes).

SUMMARY.

The old varieties Bubach, Crescent, Haverland, Warfield and Wilson are still most commonly grown as market varieties, but the Crescent and Wilson, from their liability to injury from leaf-blight, have in some sections been superseded, respectively, by Warfield and Bubach. They are all (with the exception of Wilson) pistillate varieties, and must have perfect-flowering sorts planted with them to supply pollen. Miner, Cumberland and sharpless succeed in most localities and are excellent for the purpose. Wilson and Michel are also used. For home use, or for local markets, the Cumberland, Great Pacific and Sharpless have much to recommend them. To precede these sorts by a few days, Alpha and Michel can be used, but they will be found considerably less productive than Warfield and Crescent, which follow soon.

Lovett, Mrs. Cleveland and Townsend No. 19 are also worthy of a place among early market kinds.

It is too soon to pass upon the varieties marked with an asterisk (*) in Table 1, but of the older and yet comparatively new sorts, the most promising for market are Belle, Crawford, Enhance, Florence, Muskingum, Ohio Centennial, Parker Earle and Stayman No. 1. As will be seen from the table, Parker Earle leads the others in the list by several points, but it will not succeed without the best of care. For local markets the Beder Wood, Edgar Queen, General Putnam and Hoard seem worthy of trial.

VARIETIES OF DOUBTFUL VALUE.

Of the older sorts, the following seem to have little to commend them. and as our lists are much too long, and as many of them, although sent out several years ago are not generally catalogued, they will receive no further consideration: Acme, Arlington, Auburn, Bubach No. 34, Cling-to, Clinton, Cloud, D. and D., Daisy, Dubois, Howard, Lady Rusk, Little No. 5, Logan, London No. 34, Martha, Ohio, Prince (of Berries), Shaw, Tippecanoe, Townsend No. 3, Waldron, Welch, Woodruff No. 1, Yale and Zanesfield.

STRAWBERRY LEAF-BLIGHT OR RUST.

Although some of the varieties are so nearly exempt from this disease that the crop is not noticeably lessened by it, others are so badly injured

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that what would otherwise be profitable varieties have been quite generally discarded. The disease first shows itself upon the leaves as purplish spots, these enlarge and, the center tissues being destroyed, they change to a yellowish white color. The spots are often so numerous as to destroy the leaves. The fungus also works upon, and does most injury to, the flower or fruit-stalks, as very small spots, especially upon the pedicels will serve to girdle them and thus cut off the supply of food. As a result, the berries wither and dry up. The disease is generally most troublesome upon old varieties and in plantations from which one or more crops of fruit have been taken; a dry soil and a dry season also seem to increase its effect.

While much can be done by selecting varieties as little as possible subject to scab, using plants from young plantations only, planting upon rich and fairly moist soil and conserving the moisture so far as possible by heavy mulching, or frequent shallow cultivation, it will generally pay the commercial grower, in localities where the rust is troublesome, to make use of fungicides, for the destruction of the spores of the disease, as it is now known that they are entirely efficient.

The best preparation is Bordeaux mixture prepared in the usual way, using 3 pounds of copper sulphate, 3 pounds of fresh lime and 32 gallons of water. (If leaf eating insects are present it will be of advantage to add 2 ounces of Paris green for their destruction.) A bearing plantation should be sprayed after the flower-stalks have developed and just before the blossoms open. This will serve to protect the fruit-stalks and will hold in check the rust upon the leaves. The young plantations should be sprayed at the same time. This will suffice for them until July when they should receive a second and final application, but the bearing plants, if the disease is particularly destructive, will be benefited by an intermediate application soon after the fruit has set. Care should be taken not to apply Bordeaux mixture to strawberries, or other fruits, within three weeks of the time they are to be gathered, as the lime will spot the fruit and, although there may not be enough of the copper to furnish a fatal dose, it is not a desirable thing to take into the stomach.

RASPBERRIES.

The plants were set eight by three and one-half feet, and from four to six stems were left in a hill. In June, as the young canes developed, the tips were pinched off to induce them to send out side branches. After the danger of freezing weather was over in the spring, the side shoots were cut back to lengths of from six to ten inches.

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TABLE NO. 5.—BLACK AND HYBRID RASPBERRIES.

ABBREVIATIONS.

Size.
s, small,
m, medium.
l, large.

Form.
r, round.
c, conical.
o, ovate.

Color.
b, black. g, glossy.
p, purple. l, light.
o, orange. pu, pubescent

Variety.	Vigor (1-10).	Date bloom.	First ripe fruits.	Last fruits.	Productiveness (1-10.)	Size.	Form.	Color.	Quality.
Ada	7	June 14	July 14	July 24	7	m	r	g b	8.
Caroline	6	" 14	" 11	" 22	8.5	m	r	l o	8
Columbian Red	9.5	" 13	" 16	Aug. 5	9	l	r c	p r	8.5
Conrath	9	" 7	" 7	July 24	9	l	r	b	8.
Cromwell	8.5	" 9	" 5	" 22	8.5	m	r	b	8
Farnsworth	8	" 13	" 11	" 22	8.5	m	r	b	8.5
Gregg	8.5	" 12	" 15	Aug. 5	8.5	l	r	b pu	7
Kansas	7	" 13	" 7	July 24	6	l	r	g b	8
Lovett	9	" 13	" 6	" 24	7	m	r	b	9
Nemaha	8.5	" 12	" 15	Aug. 4	9	l	r	b pu	7
Ohio	9	" 12	" 11	" 1	9.2	l	r	b	6
Older	7	" 12	" 9	July 24	8	l	r	b	9
Palmer	8.5	" 9	" 8	" 22	8.5	m	r	b	8.5
Progress	5	" 9	" 10	" 24	5	m	r c	b	8.5
Shaffer	9	" 14	" 16	Aug. 8	8	l	r o	p	8
Souhegan		" 11	" 5	July 25	9	m	r	b	8
Smith (Prolific)	7	" 12	" 11	" 24	9	l	r	b	9
Surrey	8	" 12	" 14	Aug. 5	5	m	r	b pu	7
Tyler	8	" 8	" 5	July 24	9	m	r	b	8
Virginia	9	" 9	" 11	" 24	9	l	r c	b	8.5

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NOTES ON VARIETIES.

Conrath.—The plants are productive and of vigorous growth. Canes somewhat injured by winter, but quite free from disease. The berry ripens early; is large, firm and of good quality. A very promising early variety, being the largest of the early black-caps.

Columbian Red.—Plants from J. T. Thompson, Oneida, N. Y. It is of the Shaffer type. The canes are of very strong growth and bright red color. The berry is of the color of the Shaffer, but it is firmer, less acid and better in flavor. Productive.

Cromwell.—Bushes of vigorous growth and fairly productive. Canes slightly injured by the winter. Worthy of trial as an early sort to supersede Souhegan and Tyler where they are troubled by anthracnose.

Farnsworth.—Plants from W. W. Farnsworth, Waterville, Ohio. It is not sufficiently tested, but it seems to be a promising early sort.

Gregg and Nemaha.—Among the best late, market sorts. The latter is the hardier of the two, and will be desirable where the former fails.

Kansas.—The canes were quite badly winter-killed, and the bushes were much less productive than last season. It is as large as Gregg and fully a week ahead of that sort in ripening.

Lovett.—The tips of canes winter-killed. Although it may prove more valuable than Souhegan, from its behavior thus far, it seems less desirable than Conrath and several of the other new sorts.

Ohio.—The bushes are vigorous and productive. One of the best medium-season, market sorts. It is too full of seeds to be the best type of berry for family use, but it has one valuable quality in its hardiness, which allows of its being grown in localities where other kinds fail. One of the surest of the black-caps. Much used for evaporating.

Older.—Less promising than last season, but still the equal of most sorts. Its high quality makes it valuable for home use, even if it does not prove sufficienty productive for market.

Palmer—Hardy. Bushes fairly vigorous and productive. This variety is highly esteemed as an early market black-cap and for this purpose it has few if any superiors.

Progress.—Needs further trial. Its behavior thus far does not indicate that it will take a high place.

Shaffer.—One of the best for home use and for market where its dull color and peculiar flavor are not distasteful.

Souhegan and *Tyler.*—The leading early, market sorts of past years. They are so badly injured by anthracnose that they are less commonly planted than formerly, Palmer taking their place.

Smith (*Prolific*).—Plants from Ezra G. Smith, Manchester, N. Y. The first season of fruiting. Berry large, round, jet black, firm and of best quality. Very promising as a late variety so far as can be judged from a single season's experience.

Virginia.—One of the largest and best of the early black-caps. It has generally been quite productive, and it seems well worthy of general trial.

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TABLE NO. 6.—RED RASPBERRIES.

ABBREVIATIONS.

Size.
s, small.
m, medium.
l, large.

Form.
r, round.
c, conical.
o, ovate.

Color.
d, dark. o, orange.
r, red. b, bright.
p, purple.

Variety.	Date bloom.	First ripe fruit.	Last ripe fruit.	Productiveness (1-10).	Size.	Form.	Color.	Quality.
Brandywine	June 14	July 11	July 28	7	m	rc	dr	8
Cuthbert	" 14	" 16	Aug. 6	9	l	rq	r	8
Gladstone	" 12	" 7	July 24	5	l	rc	dpu	8
Hansell	" 12	" 3	" 22	8	m	r	dr	9
Herstine	" 14	" 11	Aug. 5	8	m	r	br	9.5
Marlboro	" 16	" 7	July 24	8	m	r	r	8.5
Michigan Early	" 12	" 3	" 22	9	s	r	r	9
Miller's Woodland	" 14	" 8	" 22	7	m	r	r	8.5
Rancocas	" 15	" 11	" 24	7	m	r	r	8.5
Reder	" 14	" 8	Aug. 5	7	m	r	r	9
Red Cluster	" 16	" 8	" 5	7	m	rc	r	9
Royal Church	" 12	" 11	" 24	8.5	l	rc	dc	8.5

NOTES ON VARIETIES.

Gladstone.—The bushes bore little fruit and that was small and imperfect. Last season it promised well. Needs further trial.

Royal Church.—The bushes are hardy, vigorous and productive. The berry is of handsome appearance and high quality, but falls to pieces easily.

Hansell and *Michigan Early* are good early varieties, and Marlboro, although a failure in some sections, is all that can be desired in others.

Cuthbert is the leading market sort and as yet has no equal as a late red raspberry for market purposes.

Golden Queen for home use is worthy of a place. It resembles Cuthbert in plant, but the berries are of superior quality and of a yellow color.

ANTHRACNOSE.

Raspberries, both red and black, have been much troubled with this disease. As a preventive it is desirable to obtain plants from young plantations. In case the disease shows itself, the treatment should be the same as practiced at South Haven (see page 71, Bulletin 104), cutting out all badly diseased canes and spraying with Bordeaux mixture. In severe cases, an application of the fungicide should be made just before the growth starts, and should be repeated, at intervals of two weeks, after the canes start, until the fruit is half grown. As soon as the crop is harvested, remove the old canes, thin out the new ones and spray thoroughly. While this may not be entirely effectual in keeping the disease from showing itself in an old plantation, it will prevent serious loss.

AGRICULTURAL COLLEGE,
February 10, 1894.

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FATTENING LAMBS.

F. B. MUMFORD.

Bulletin No. 107.—Farm Department.

Michigan has long held a prominent place as a sheep producing state. In recent years especially, her farmers have attained no small degree of success in the business of fattening sheep and lambs for the eastern markets. So extensive has the industry become, and so successful have been the feeders engaged in the business, that Michigan lambs have obtained a desirable reputation among eastern buyers. There are, in general, two classes of farmers engaged in the production of mutton. One class feed enough sheep to consume the coarse fodder and grain produced on the farm, the other depends upon purchasing all or nearly all of the food consumed. To either of these classes any experiment tending to determine the relative values of some of our common food stuffs for fattening purposes, is a matter of interest and importance.

On investigation we were led to believe that corn, oats, and bran, either alone or in combination, were the grains most commonly used in Michigan for fattening sheep. Corn and oats are produced here in great abundance, and close proximity to the great corn producing districts of the west has induced our feeders to purchase annually, thousands of car loads of western corn. Wheat bran can be obtained in nearly every county of the State and is largely purchased for mixing with other grains.

The following experiment is the first of a series intended to investigate the comparative values of these common grains for fattening purposes, and incidentally the consideration of some points of interest growing out of our experience in fattening lambs. Exact experiments tending to fix a standard of meat production for our different grains, are lacking. How many pounds of corn with a definite amount of clover hay will produce a pound of mutton or beef? How many pounds of corn and bran, or corn and oats with a like amount of hay will produce a pound of mutton or beef? The question is an exceedingly complicated one, and its solution dependent on so many conditions that the results at best could be only approximate. How-

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ever even such a standard would be of great service to the practical feeder, and the answers to the above questions would go a long way toward deciding on the selection of feeding rations. All the conditions were made as nearly identical as possible, except the grain rations. The comparison was between corn, oats, and bran, either each fed alone as a grain ration, or in combination.

PLAN OF THE EXPERIMENT.

The plan was to secure as nearly an average lot of lambs as possible, representing the class of animals usually purchased by feeders for fattening. Our aim was to obtain lambs from one flock in order that the animals used in the experiment might have the advantage of having been under the same conditions for some time previous. We were fortunate in securing a lot numbering 125 lambs of similar breeding, and in all respects a desirable flock for experimental purposes. They were divided into 10 lots numbered consecutively from 1–10. They were confined in a light airy barn, well ventilated and supplying the best of conditions for the health and comfort of the animals. The feeding pens were roomy and so constructed that lambs could be confined at one end while the feeding was in progress. The lambs were at no time permitted to exercise in the open air and were not taken out except for the purpose of weighing once each week. Pure water, frequently renewed, was kept constantly before the animals, but was not weighed. In all lots except 8 and 9, the influence of the individual differences of the animals was guarded against as much as possible by carefully grading into lots of the same weight and apparent thrift. The large number of animals used in each division of the experiment also contributed toward making the averages more reliable. Care was taken to feed at regular intervals. They were fed grain and hay at 6:30 each morning, roots and silage at 12, and grain and hay again at 3:30.

In all the lots except 8 and 9, the amounts of hay and grain were supplied with reference to the appetites of the animals, while the roots were supplied at the rate of one pound per day and head.

Lots 8 and 9 were fed for the purpose of determining the relative value of roots and silage for fattening lambs, and was a continuation of a former experiment along the same line. The animals however, were apparently in no way less thrifty than the others and the results are included in the general summaries and tabulated comparisons. Lots 8 and 9 each received clover hay *ad libitum* and a grain ration consisting of one pound per day and head of bran and oats, mixed equal parts by weight. In addition lot 8 was fed ruta bagas *ad libitum* and lot 9 corn silage *ad libitum*.

December 3, 1892, the lambs were all dipped in kerosene emulsion. The excitement of dipping and discomfort following the operation probably slightly affected the gains, especially as the time of dipping was followed immediately by a fall in temperature.

All the feed except hay was weighed daily and recorded. The weights of hay were recorded for the weekly periods only. The lambs were weighed each week on the dates given in the tables. The weighing was done each time in the morning after a feed of grain and before feeding hay or supplying with water.

The lambs were all shorn during the week ending March 8.

We were desirous of ascertaining the influence of shearing lambs during

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the fattening period, and a discussion of the results will be found in another portion of this bulletin.

HISTORY OF THE ANIMALS.

The 125 lambs used in this experiment were purchased on September 25, 1892. They were sired by a well bred shropshire ram from the common grade ewes of the state. Merino blood largely predominates in the common flocks of Michigan, and these we believe fairly represented the majority of lambs fed in the state. On their arrival at the college farm they were given a liberal feed of oats and hay and turned immediately on a field of rape,* where they remained 35 days. They gained 15 lbs per head while pasturing on rape and were in excellent condition when placed in winter quarters. They were fed on a light ration of grain, consisting of oats and bran, and clover hay, until Nov. 30, 1892, when the experiment proper began. From this time until March 29, 1893, at which time the experiment terminated, all food consumed was carefully weighed and a daily record kept.

KIND AND COST OF FOOD STUFFS.

The corn used in this experiment was fed whole and was either grown on the college farm or in the immediate neighborhood, except a small quantity of western corn purchased to complete the experiment.

The oats were of the American Banner variety, grown on the college farm and of prime quality. They were also fed whole.

The wheat bran was purchased of our local millers and was the residue from the manufacture of roller process flour.

The clover hay was an excellent sample of bright, well cured clover and was readily eaten by the lambs in all lots. The silage was produced from a medium maturing yellow dent corn. The corn was well glazed at the time of the siloing and the silage resulting was probably above the average in quality. It was cut in one-half inch lengths and the filling alternated between two silos, filling the first one day and the other the next.

Silage is a very indefinite substance; its value depends so much on the time of harvesting, kind of corn used, and manner of filling that the use of tables already established is attended with some uncertainty. The silage in this experiment was analyzed and its composition found to agree very closely with the figures given in the tables.

The ruta bagas were of the variety known as Skirving's Purple Top. They were sliced before feeding and were greedily eaten by the lambs in all lots.

The following table gives the prices of food stuffs as quoted to us by a local dealer:

Corn	$0 56	per bushel.
Oats	32	" "
Bran	13 75	per ton.
Hay	7 00	" "
Silage	2 50	" "
Ruta Bagas	2 50	" "

*The field of rape comprised 12 acres and was of the variety known as Hybrid Bird rape.

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When in any case a mixture of grain was used the mixture was invariably composed of equal parts by weight as follows:

Corn and bran equal parts by weight.

Corn and oats equal parts by weight.

Oats and bran equal parts by weight.

Corn, oats and bran equal parts by weight.

Below are arranged the average daily fodder rations consumed by each lamb:

AVERAGE DAILY RATIONS FOR ONE LAMB.

Lot 1.

Corn	1.47 lbs.
Roots	1. "
Hay	1.4 "
Nutritive Ratio	1:7.8
Total cost	2.09 cts.

Lot 2.

Oats	1.64 lbs.
Hay	1.4 "
Roots	1. "
Nutritive ratio	1:6.4
Total cost	2.27 cts.

Lot 3.

Bran	1.49 lbs.
Roots	1. "
Hay	1.45 "
Nutritive ratio	1:5.13
Total cost	1.66 cts.

Lot 4.

Corn	.81 lbs.
Oats	.81 "
Hay	1.43 "
Roots	1. "
Nutritive ratio	1:7
Total cost	2.25 cts.

Lot 5.

Corn	.83 lbs.
Bran	.83 "
Hay	1.42 "
Roots	1. "
Nutritive ratio	1:6.59
Total cost	2.02 cts.

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Lot 6.

Oats	.82 lbs.
Bran	.82 "
Hay	1.44 "
Roots	1. "
Nutritive ratio	1:5.6
Total cost	2.01 cts.

Lot 7.

Corn	.55 lbs.
Oats	.55 "
Bran	.55 "
Hay	1.4 "
Roots	1. "
Nutritive ratio	1:6.
Total cost	2.09 cts.

Lot 8.

Oats	.5 lbs.
Bran	.5 "
Hay	1.20 "
Roots	5.6 "
Nutritive ratio	1:6.25
Total cost	1.89 cts.

Lot 9.

Oats	.5 lbs.
Bran	.5 "
Hay	.82 "
Silage	3.40 "
Nutritive ratio	1:7.6
Total cost	1.54 cts.

Lot 10.

Corn	.84 lbs.
Oats	.84 "
Bran	.84 "
Hay	.62 "
Roots	1.61 "
Nutritive ratio	1:6.8 "
Total cost	2.67 cts.

DETAILED RECORD OF EXPERIMENT.

The following tables contain the weekly records of food consumed and gains resulting from each lot. For convenience of reference the financial statement is placed immediately following the records of feed and gain:

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LOT 1. (10 Lambs.)

Weekly record of feed, weight and gain. (*Grain ration—Corn.*)

Dates.	Corn.	Hay.	Roots.	Total weight.	Total gain.	Avg. weight.	Avg. weekly gain.
November 30				830		83	
December 7	52	105	70	866	36	86	3.6
" 14	70	105	70	875	9	87	.9
" 21	70	105	70	884	9	88	.9
" 28	70	105	70	904	20	90	2
January 4	70	100	70	910	6	91	.6
" 11	70	100	70	952	42	95	4.2
" 18	105	100	70	1,006	54	100	5.4
" 25	105	100	70	1,020	14	102	1.4
February 1	140	105	70	1,045	25	104	2.5
" 8	140	105	70	1,069	24	107	2.4
" 15	123	105	70	1,092	23	109	2.3
" 22	108	90	70	1,130	38	113	3.8
March 1	106	90	70	1,124	-6	112	-.6
" 8	120	90	70	1,135	11	113	1.1
" 15	138	90	70	1,175	40	117	4
" 22	140	90	70	1,229	54	123	5.4
" 29	130	90	70	1,273	44	127	4.4
Totals	**1,757**	**1,675**	**1,190**		**448**		

FINANCIAL STATEMENT.

Lot 1. (*10 Lambs.*)

DEBIT.

To 10 lambs, 830 lbs. @ 5 cts.	$41 50
shearing 10 lambs	70
To feed as follows:	
1,757 lbs. corn @ 56 cts. per bu.	17 57
1,190 lbs. roots @ $2.50 per ton	1 49
1,670 lbs. hay @ $7.00 per ton	5 85
Total expenditures	$67 11

CREDIT.

By 10 lambs, 1,205.5 lbs. @ 5 cts.	$60 27
wool, 67.5 lbs. @ 21 cts.	14 18
Total receipts	$74 45
Profit on one lamb	73

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LOT 2. (10 Lambs).

Weekly record of feed, weight and gain. (*Grain ration—Oats.*)

Dates.	Oats.	Hay.	Roots.	Total weight.	Total gain.	Avg. weight.	Avg. weekly gain.
November 30				834		83	
December 7	52	103	70	856	22	85	2.2
" 14	70	103	70	866	10	86	1
" 21	70	103	70	877	11	88	1.1
" 28	70	103	70	870	-7	87	-.7
January 4	70	118	70	850	-20	85	-2
" 11	70	118	70	916	66	91	6.6
" 18	105	118	70	950	34	95	3.4
" 25	105	118	70	958	8	96	.8
February 1	140	100	70	1,000	42	100	4.2
" 8	148	100	70	1,019	19	102	1.9
" 15	148	100	70	1,038	19	104	1.9
" 22	154	100	70	1,064	26	106	2.6
March 1	154	82	70	1,094	30	109	3
" 8	154	82	70	1,085	-9	108	-.9
" 15	154	82	70	1,123	38	112	3.8
" 22	154	82	70	1,173	50	117	5
" 29	145	82	70	1,213	40	121	4
Totals	**1,963**	**1,694**	**1,190**		**379**		

FINANCIAL STATEMENT.

Lot 2. (*10 Lambs.*)

DEBIT.

To 10 lambs, 834 lbs. @ 5 cts.	$41 70
shearing 10 lambs	70
To feed as follows:	
1,963 lbs. oats @ 32 cts. per bu.	19 63
1,160 lbs. roots @ $2.50 per ton	1 49
1,687 lbs. hay @ $7.00 per ton	5 90
Total expenditures	$69 42

CREDIT.

By 10 lambs, 1,145.5 lbs. @ 5 cts.	$57 27
wool, 67.5 lbs, @ 21 cts.	14 18
Total receipts	$71 45
Profit on one lamb	20

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LOT 3. (10 Lambs.)

Weekly record of feed, weight and gain. (Grain ration—Bran.)

Dates.	Bran.	Hay.	Roots.	Total weight.	Total gain.	Avg. weight.	Avg. weekly gain.
November 30				824		82	
December 7	52	104	70	842	18	84	1.8
" 14	70	104	70	852	10	85	1
" 21	70	104	70	864	12	86	1.2
" 28	70	104	70	882	18	88	1.8
January 4	70	118	70	862	-20	86	-2
" 11	70	118	70	896	34	89	3.4
" 18	105	118	70	932	36	93	3.6
" 25	105	118	70	944	12	94	1.2
February 1	125	105	70	944	0	94	0
" 8	119	105	70	954	10	95	1
" 15	119	105	70	960	6	96	.6
" 22	122	105	70	994	34	99	3.4
March 1	137	84	70	1,025	31	102	3.1
" 8	140	84	70	1,020	-5	102	-.5
" 15	146	84	70	1,022	2	102	.2
" 22	138	84	70	1,054	32	105	3.2
" 29	121	84	70	1,066	12	106	1.2
Totals	**1,779**	**1,728**	**1,190**		**242**		

FINANCIAL STATEMENT.

Lot 3. (10 Lambs.)

DEBIT.

To 10 lambs 824 lbs. @ 5 cts.	$41 20
shearing 10 lambs	70
To feed as follows:	
1,779 lbs. bran @ $13.75 per ton	12 22
1,190 lbs. roots @ $2.50 " "	1 49
1,737 lbs. hay @ $7.00 " "	6 08
Total expenditures	$61 69

CREDIT.

By 10 lambs, 998.5 lbs. @ 5 cts.	$49 92
wool 67.5 lbs. @ 21 cts.	14 18
Total receipts	$64 10
Profit on one lamb	24

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LOT 4. (10 Lambs.)

Weekly record of feed, weight and gain. (Grain ration—Corn and Oats.)

Dates.	Corn and oats.	Hay.	Roots.	Total weight.	Total gain.	Avg. weight.	Avg. weekly gain.
November 30				842		84	
December 7	52	116	70	864	22	86	2.2
" 14	70	116	70	872	8	87	.8
" 21	70	116	70	882	10	88	1
" 28	70	116	70	898	16	90	1.6
January 4	70	102	70	900	2	90	.2
" 11	70	102	70	936	36	93	3.6
" 18	105	102	70	988	52	99	5.2
" 25	105	102	70	1,000	12	100	1.2
February 1	140	96	70	1,039	39	104	3.9
" 8	148	96	70	1,056	17	105	1.7
" 15	148	96	70	1,078	22	108	2.2
" 22	134	96	70	1,110	32	111	3.2
March 1	140	91	70	1,138	28	114	2.8
" 8	150	91	70	1,160	22	116	2.2
" 15	154	91	70	1,177	17	118	1.7
" 22	154	91	70	1,224	47	122	4.7
" 29	155	91	70	1,278	54	128	5.4
Totals	**1,985**	**1,711**	**1,190**		**436**		

FINANCIAL STATEMENT.

Lot 4. (10 Lambs.)

DEBIT.

To 10 lambs 842 lbs. @ 5 cts.	$42 10
shearing 10 lambs	70
To feed as follows:	
1,935 lbs. corn and oats	19 35
1,190 lbs. roots @ $2.50 per ton	1 49
1,711 lbs. hay at $7.00 " "	5 98
Total expenditures	$69 62

CREDIT.

By 10 lambs 1,210.5 lbs. @ 5 cts	$60 52
wool 67.5 lbs. @ 21 cts.	14.18
Total receipts	$74 70
Profit on one lamb	$1

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LOT 5. (10 Lambs.)

Weekly record of feed, weight and gain. (*Grain ration—Corn and bran.*)

Dates.	Corn and bran.	Hay.	Roots.	Total weight.	Total gain.	Avg. weight.	Avg. weekly gain.
November 30				866		86	
December 7	52	120	70	880	14	88	1.4
" 14	70	120	70	890	10	89	1
" 21	70	120	70	902	12	90	1.2
" 28	70	120	70	916	14	91	1.4
January 4	70	104	70	910	-6	91	-.6
" 11	70	104	70	946	36	94	3.6
" 18	105	104	70	990	44	99	4.4
" 25	105	104	70	1,010	20	101	2
February 1	140	98	70	1,020	10	102	1
" 8	148	98	70	1,045	25	104	2.5
" 15	148	98	70	1,072	27	107	2.7
" 22	154	98	70	1,122	50	112	5
March 1	154	82	70	1,148	26	115	2.6
" 8	154	82	70	1,144	-4	114	-.4
" 15	154	82	70	1,126	-11	112	-1.8
" 22	154	82	70	1,198	72	120	7.2
" 29	155	82	70	1,224	26	122	2.6
Totals	**1,973**	**1,698**	**1,190**		**358**		

FINANCIAL STATEMENT.

Lot 5. (*10 Lambs.*)

DEBIT.

To 10 lambs 866 lbs. @ 5 cts.	$43 30
shearing 10 lambs	70
To feed as follows:	
1,973 lbs. corn and bran	16 64
1,190 lbs. roots @ $2.50 per ton	1 49
1,698 lbs. hay at $7.00 " "	5 94
Total expenditures	$68 07

CREDIT.

By 10 lambs 1,156.5 lbs. @ 5 cts	$57 82
wool 67.5 @ 21 cts	14 18
Total receipts	$72 00
Profit on one lamb	39

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LOT 6. (15 Lambs.)

Weekly record of feed, weight and gain. (Grain ration—Oats and bran.)

Dates.	Oats and bran.	Hay.	Roots.	Total weight.	Total gain.	Avg. weight.	Avg. weekly gain.
November 30				1,258		84	
December 7	72	157	105	1,286	28	86	1.8
" 14	105	157	105	1,293	7	86	.4
" 21	105	157	105	1,302	9	87	.4
" 28	105	157	105	1,324	22	88	1.4
January 4	105	156	105	1,302	-22	87	-1.4
" 11	105	156	105	1,368	66	91	4
" 18	157	156	105	1,408	40	94	2.8
" 25	157	156	105	1,460	52	97	3.5
February 1	210	150	105	1,482	22	99	1.4
" 8	222	150	105	1,521	39	101	2.5
" 15	222	150	105	1,560	39	104	2.6
" 22	231	150	105	1,596	36	106	2.4
March 1	231	146	105	1,624	28	108	1.8
" 8	231	146	105	1,642	18	109	1.3
" 15	213	146	105	1,659	17	111	1.3
" 22	231	146	105	1,771	112	118	7.4
" 29	233	146	105	1,799	28	120	1.8
Totals	**2,985**	**2,582**	**1,785**		**541**		

FINANCIAL STATEMENT.

Lot 6. (15 Lambs.)

DEBIT.

To 15 lambs, 1,258 lbs. @ 5 cts.	$62 90
shearing 15 lambs	1 05
To feed as follows:	
2,935 lbs. oats and bran	24 76
1,785 lbs. roots @ $2.50 per ton	2 23
2,580 lbs. hay @ $7.00 per ton	9 03
Total expenditures	$99 97

CREDIT.

By 15 lambs, 1,697.75 lbs. @ 5 cts.	$84 88
wool 101.25 lbs. @ 21 cts.	21 26
Total receipts	$106 14
Profit on one lamb	41

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LOT 7. (15 Lambs.)

Weekly record of feed, weight and gain. (Grain ration—Corn, oats and bran.)

Dates.	Corn, oats and bran.	Hay.	Roots.	Total weight.	Total gain.	Avg. weight.	Avg. weekly gain.
November 30				1,250		83	
December 7	72	150	105	1,294	44	86	3
" 14	105	150	105	1,304	10	87	.7
" 21	105	150	105	1,316	12	88	.8
" 28	105	150	105	1,344	28	90	2
January 4	105	154	105	1,320	-24	88	-1.6
" 11	105	154	105	1,380	60	92	4
" 18	157	154	105	1,430	50	95	3.3
" 25	157	154	105	1,486	56	99	3.7
February 1	210	135	105	1,492	6	100	.4
" 8	222	135	105	1,530	38	102	3
" 15	222	135	105	1,568	38	105	3
" 22	231	135	105	1,625	57	108	4
March 1	231	145	105	1,666	41	111	3
" 8	231	145	105	1,690	24	113	1.6
" 15	231	145	105	1,703	13	114	1
" 22	231	145	105	1,787	84	119	6
" 29	233	145	105	1,831	44	122	3
Totals	**2,953**	**2,481**	**1,785**		**581**		

FINANCIAL STATEMENT.

Lot 7. (15 Lambs.)

DEBIT.

To 15 lambs, 1,250 lbs. @ 5 cts.	$62 50
shearing 15 lambs	1 05
To feed as follows:	
2,953 lbs. corn, oats and bran	26 75
1,785 lbs. roots @ $2.50 per ton	2 23
2,481 lbs. hay @ $7.00 per ton	8 68
Total expenditures	$101 21

CREDIT.

By 15 lambs, 1,729.75 lbs. @ 5 cts.	$86 49
wool 101.25 lbs. @ 21 cts.	21 26
Total receipts	$107 75
Profit on one lamb	44

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LOT 8. (20 Lambs.)

Weekly record of feed, weight and gain. (Grain ration—Oats and bran.)

Dates.	Oats and bran.	Hay.	Roots.	Total weight.	Total gain.	Avg. weight.	Avg. weekly gain.
November 30				1,462		73	
December 7	105	143	100	1,486	24	74	1.2
" 14	140	143	318	1,520	34	76	1.7
" 21	140	143	485	1,556	36	78	1.8
" 28	140	143	560	1,632	76	81	3.8
January 4	140	145	560	1,605	-27	80	-1.3
" 11	140	145	560	1,650	45	82	2.2
" 18	140	145	620	1,706	56	85	2.8
" 25	140	145	800	1,750	44	87	2.2
February 1	140	148	900	1,750	0	87	0
" 8	140	148	1,010	1,783	33	89	1.6
" 15	140	148	1,020	1,816	33	90	1.6
" 22	140	148	1,040	1,866	50	93	2.5
March 1	140	139	1,020	1,909	43	95	2.1
" 8	140	139	1,020	1,936	27	96	1.3
" 15	140	139	1,020	1,925	-11	96	-.5
" 22	140	139	1,120	2,003	78	100	3.9
" 29	140	139	960	2,051	48	102	2.4
Totals	**2,845**	**2,439**	**13,413**		**589**		

FINANCIAL STATEMENT.

Lot 8. (20 Lambs.)

DEBIT.

To 20 lambs, 1,462 lbs. @ 5 cts.	$73 10
shearing 20 lambs	1 40
To feed as follows:	
2,345 lbs. bran and oats	19 86
13,413 lbs. roots @ $2.50 per ton	16 76
2,439 lbs. hay @ $7.00 per ton	8 51
Total expenditures	$119 63

CREDIT.

By 20 lambs, 1,916 lbs. @ 5 cts.	$95 85
wool, 135 lbs. @ 21 cts.	28 30
Total receipts	$124 15
Profit on 1 lamb	22

40

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LOT 9. (20 Lambs.)

Weekly record of feed, weight and gain. (Grain ration—Oats and bran.)

Dates.	Oats and bran.	Hay.	Silage.	Total weight.	Total gain.	Avg. weight.	Avg. weekly gain.
November 30				1,490		74	
December 7	105	151	100	1,514	24	75	1.2
" 14	140	151	318	1,558	44	78	2.2
" 21	140	151	485	1,598	40	79	2
" 28	140	151	560	1,636	38	81	1.9
January 4	140	93	375	1,616	-20	80	-1
" 11	140	93	375	1,682	66	84	3.3
" 18	140	93	505	1,744	62	87	3.1
" 25	140	93	550	1,752	8	87	.4
February 1	140	112	525	1,762	10	88	.5
" 8	140	112	525	1,797	35	89	1.7
" 15	140	112	525	1,832	35	91	1.7
" 22	140	112	545	1,880	48	94	2.4
March 1	140	110	560	1,890	10	94	.5
" 8	140	110	560	1,940	50	97	2.5
" 15	140	110	560	1,950	10	97	.5
" 22	140	110	560	2,018	68	100	3.4
" 29	140	110	480	2,076	58	103	2.9
Totals	**2,845**	**1,974**	**8,108**		**586**		

FINANCIAL STATEMENT.

Lot 9. (20 Lambs.)

DEBIT.

To 20 lambs, 1,490 lbs. @ 5 cts.	$74 50
shearing 20 lambs	1 40
To feed as follows:	
2,345 lbs. oats and bran	19 86
8,108 lbs. silage @ $2.50 per ton	10 13
1,974 lbs. hay @ $7.00 per ton	6 91
Total expenditures	$112 80

CREDIT.

By 20 lambs, 1,941 lbs. at 5 cts.	$97 05
wool, 133 lbs. @ 21 cts.	28 35
Total receipts	$125 40
Profit on one lamb	63

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LOT 10. (5 Lambs.)—*Self feed.*

Weekly record of feed, weight and gain. (Grain ration—Corn, oats and bran.)

Dates.	Corn, oats and bran.	Hay.	Roots.	Total weight.	Total gain.	Avg. weight.	Avg. weekly gain.
December 7				422		84	
" 14	134	14	100	431	9	86	1.8
" 21	78	17	110	440	9	88	1.8
" 28	120	15	105	452	12	90	2.4
January 4	36	16	85	464	12	93	2.4
" 11	105	19.5	35	478	14	95	2.8
" 18	104	34.5	35	486	8	96	1.6
" 25	60	18	35	498	12	99	2.4
February 1	131	30	35	509	11	101	2.2
" 8	30	16	35	523	14	104	2.8
" 15	96	33	35	538	15	106	3
" 22	67	15	35	550	12	110	2.4
March 1	100	36	35	552	2	110	.4
Totals	**1,060**	**264**	**680**		**130**		

FINANCIAL STATEMENT.

Lot 10. (5 Lambs.)

DEBIT.

To 5 lambs, 422 lbs. @ 5 cts.	$21 10
shearing 5 lambs	35
To feed as follows:	
1,060 lbs. corn, oats and bran	9 49
264 lbs. hay @ $7.00 per ton	92
680 lbs. roots @ $2.50 per ton	85
Total expenditures	$32 71

CREDIT.

By 5 lambs, 518.25 lbs. @ 5 cts.	$25 91
wool, 33.75 lbs. @ 21 cts.	7 09
Total receipts	$33 00
Profit on one lamb	06

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SUMMARY OF TOTALS.

Totals of food, weights and gains.

Lot.	No. lambs.	Grain.	Hay.	Roots.	Cost of feed.	Gain.	Average weekly gain.
1	10	1,757	1,675	1,190	$24 92	443	2.6
2	10	1,968	1,694	1,190	27 05	379	2.2
3	10	1,779	1,728	1,190	19 77	242	1.4
4	10	1,785	1,711	1,190	26 83	436	2.6
5	10	1,978	1,698	1,190	24 07	858	2.1
6	15	2,985	2,582	1,785	36 02	541	2.1
7	15	2,958	2,481	1,785	37 36	581	2.8
8	20	2,845	2,439	18,418	45 08	589	1.7
9	20	2,845	1,974	*8,108	36 82	586	1.7
10	5	1,060	264	680	11 26	180	2.16

* Silage.

EXPLANATIONS.

The tables for each lot contain a weekly record of kind and amounts of food consumed, total weight at end of each period, total gain of entire lot, average weight, and average weekly gain of one sheep.

The summary of totals contains number of lambs in each lot, total weights of food consumed, cost of food, and gain of each lot, and average gain of one sheep for one week.

Lot 10 which was fed with a "self feed" were under experiment for 12 weeks only, and in every case the totals and averages are based on the feeding period of 12 weeks.

The lambs in all lots were shorn during the week ending March 8, 1893, and weights of wool recorded after the above date, to avoid confusion in the tables; the total weights are found by adding weight of wool to actual weight of shorn sheep.

The lambs averaged 6.75 lbs. of wool per head, and this average amount is in each case calculated in the financial statement. The wool was consigned to a Philadelphia firm and netted 21 cts. here.

The minus (—) sign before numbers in column of gains indicates a loss.

The lambs fed well, although the gains were not as satisfactory as in other experiments conducted at this station. During the week ending Jan. 4, the lambs were nearly all "off their feed," caused by overfeeding. With this exception, the lambs were at all times apparently thriving well.

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TABLE I.—*Showing weekly gain, cost of 1 lb. gain, pounds of grain to 1 lb. gain, protein fed per day per 1,000 lbs of sheep live weight, carbohydrates fed per day per 1,000 lbs. of sheep live weight, and nutritive ratio.*

Lot.	Distinguishing rations.	Weekly gain.	Cost of 1 pound gain.	Pounds of grain fed to 1 pound gain.	Protein fed per day per 1,000 pounds.	Carbohydrates fed per day per 1,000 lbs.	Nutritive ratio.
1	Corn	2.6	$.056	3.96	2.2	16.7	1:7.8
2	Oats	2.2	.078	5.17	2.4	15.89	1:6.4
3	Bran	1.4	.081	7.35	2.9	14.8	1:5.1
4	Corn and oats	2.6	.061	4.4	2.37	16.8	1:7
5	Corn and bran	2.1	.067	5.5	2.56	16.2	1:6.5
6	Oats and bran	2.1	.066	5.4	2.6	14.9	1:5.6
7	Corn, oats and bran	2.8	.064	5.08	2.6	16	1:6
8	Roots	1.7	.076	3.98	2.4	15.4	1:6.2
9	Silage	1.7	.062	4	2.2	14.5	1:7.6
10	"Self feed"	2.16	.086	8.15	3	19.2	1:6.8

The pounds of grain required to produce a pound of gain in the various lots is an interesting point. From table 1 it will be observed that the least number of pounds required for 1 lb. gain is in Lot 1, fed with corn and clover hay. The largest quantity of grain eaten to produce 1 pound gain was in Lot 10, fed with a "self feed." In all rations containing corn the amount of grain necessary to produce 1 pound of gain, is less than in the other rations with the exception of lambs fed with a "self feed" as mentioned above.

POINTS OF INTEREST.

It has been argued by practical feeders that the results obtained from comparing lots of 1, 2 or 3 animals are unreliable. The individual differences of the animals are often so great that conclusions based upon so few animals may be misleading. In the experiment under discussion the utmost care was taken not only to carefully divide the animals into lots of equal weight, and general thrift, but also to employ a sufficiently large number of animals in each lot, so that as much as possible, we might overcome the influence of the individual differences of the animals.

The length of the experiment also, (119 days) will contribute toward making the results the more valuable.

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TABLE 2.—*Gains by weeks.*

Dates.	Lot 1.	Lot 2.	Lot 3.	Lot 4.	Lot 5.	Lot 6.	Lot 7.	Lot 8.	Lot 9.	Lot 10.	Weekly average.
Nov. 30											
Dec. 7	3.6	2.2	1.8	2.2	1.4	1.8	3.0	1.2	1.2		2.0
" 14	.9	1.0	1.0	.8	1.0	.4	.7	1.7	2.2	1.8	1.8
" 21	.9	1.1	1.2	1.0	1.2	.4	.8	1.8	2.0	1.8	1.2
" 28	1.0	-.7	1.8	1.6	1.4	1.4	2.0	3.8	1.9	2.4	1.6
Jan. 4	1.6	-2	-2	.2	-.6	-1.4	-1.6	-1.3	-1	2.4	-.5
" 11	4.2	6.6	3.4	3.6	3.6	4.0	4.0	2.2	3.3	2.8	3.7
" 18	5.4	3.4	3.6	5.2	4.4	2.8	3.3	2.8	3.1	1.6	3.5
" 25	1.4	.8	1.2	1.2	2.0	3.5	3	2.2	.4	2.4	1.8
Feb. 1	2.5	4.2	0	3.9	1.0	1.4	.4	0	.5	2.2	1.6
" 8	2.4	1.9	1.0	1.7	2.5	2.5	3.0	1.6	1.7	2.8	2.1
" 15	2.3	1.9	.6	2.2	2.7	2.6	3.0	1.6	1.7	3	2.1
" 22	3.8	2.6	3.4	3.2	5.0	2.4	4.0	2.5	2.4	2.4	3.1
Mar. 1	-.6	3.0	3.1	2.8	2.6	1.8	3.0	2.1	.5	.4	1.8
" 8	1.1	-.9	-.5	2.2	-.4	1.3	1.6	1.3	2.5		.9
" 15	4.0	3.8	.2	1.7	1.8	1.3	1.0	-.5	.5		1.1
" 22	5.4	5.0	3.2	4.7	7.2	7.4	6.0	3.9	3.4		5.1
" 29	4.4	4.0	1.2	5.4	2.6	1.8	3.0	2.4	2.9		3

Table 2 is added for convenience of reference. It contains the average weekly gain of one lamb in each lot for each week during the entire period of 17 weeks. The averages of the 10 lots for each week will be found in column headed "weekly average."

The amount of hay eaten with the different grain rations is a matter of interest. Table 3 gives the proportion of grain to hay. The lambs receiving a large daily ration of roots consumed a large quantity of hay as compared with grain, and those fed with "self feed" consumed relatively a very small amount of hay. Lot 1 fed corn, and lot 3 fed oats, consumed a relatively larger amount of hay than did the other lots in the distinctively grain test.

TABLE 3.—*Relation of hay to grain.*

Lot.	Pounds hay.	Pounds grain.
1	.96	1
2	.85	1
3	.97	1
4	.88	1
5	.86	1
6	.87	1
7	.84	1
8	1.40	1
9	.84	1
10	.24	1

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One thing seems to be quite clearly indicated by this experiment, viz.: that small gains are not necessarily unprofitable, nor large gains a sure index of profitable food consumption. (Compare lots 9 and 10.) Lot 9 made an average weekly gain of 1.7 lbs. per head, and yielded a profit of 63 cts. per head. Lot 10 made a weekly gain of 2.16 lbs. per head and yielded a profit of only 6 cts per head.

SELF FEED.

By "self feed" is understood any arrangement which admits of free access to grain at all times.

It is a common practice among feeders in many parts of this state to use a "self feed." Many employ this method during the whole feeding period. Others believe that better results are obtained by using it during the latter period of fattening. So common is this practice that it was thought advisable to investigate the value of this method as compared with regular times of feeding.

To determine its value five lambs were placed in Lot 10. They were fed clover hay *ad libitum* and 1 pound of ruta bagas per day and head.

The grain ration consisted of corn, oats, and bran mixed equal parts by weight. This grain ration was placed in a conveniently constructed box arranged so that lambs could feed at will. Some care was necessary in accustoming the lambs to the heavy feed of grain before they were allowed constant access to the "self feed" arrangement.

The lambs were fed thus from December 7, 1892, to March 1, 1893, a period of twelve weeks. During this time they consumed 1,060 lbs. of grain, 264 lbs. of hay, and 680 lbs. of roots. They gained during this time 130 lbs., or 2.16 lbs. per head and week. It will be observed that the lambs ate a large amount of grain, and a relatively small amount of hay. Although the gain was slightly above the average, and the lambs apparently well fattened, it will be noticed from table 1, that as compared with the other lots the gain was made at the highest cost per pound. It will also be observed that it required more pounds of grain to one pound of gain than in any of the other lots.

It will be seen from the financial statement that of all the lots these were fed at the least profit; namely 6 cts. per lamb. Owing to the small number of lambs in this division of the experiment, we are not prepared to say that the "self feed" is unprofitable, without further investigation. The indications of this experiment, however, point to the fact that it may be an expensive method of fattening lambs.

ROOTS VS. SILAGE FOR FATTENING LAMBS.

In a former experiment (bulletin 84) conducted at this station some of the conclusions drawn were as follows:

"1. This experiment indicates the superiority of roots (sugar beets) over silage for fattening lambs.

2. Either roots or silage may enter largely into the fattening ration and allowing a reasonable valuation on each, may be fed with profit.

3. Lambs may be successfully fattened without the use of a heavy grain ration."

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To further investigate this subject 40 lambs were divided into two lots and appear in the tables as lots 8 and 9. The silage used in this experiment was above the average in quality. The roots used were ruta bagas. The results appear in former pages of this bulletin.

The gains produced by each ration were the same, namely: 1.7 lbs, per week and head. It will be observed, however, that although the quantity of grain fed was the same, that the lambs fed ruta bagas consumed a considerably larger quantity of hay than those fed silage. The amount of roots eaten by lot 8, as compared with the silage eaten by lot 9, was very large.

The profit on lot 8, fed roots, was 22 cts. on each lamb, that on lot 9 fed silage was 63.

We are led to conclude, therefore, that considering the ruta bagas and silage used in this experiment (see page 5) the silage produced the same gain at a less cost.

The results of this experiment as compared with bulletin 84 would seem to indicate the superiority of sugar beets over ruta bagas for fattening lambs.

The conclusions quoted above (bulletin 84, Michigan) are still further confirmed by this experiment.

SHEARING LAMBS DURING THE FATTENING PERIOD.

Shearing lambs during some part of the feeding period has been practiced with more or less success in this state. In many cases the animals are shorn in the fall. More often, however, the shearing is done sometime in March, 3 or 4 weeks before it is desired to dispose of the sheep. To observe the advantages, if any, resulting from this practice, all the animals in this experiment were shorn during the week ending March 8, 1893. They were continued on the rations as before until March 29, 1893, thus making a period of 3 weeks after shearing. Taking the average of all the lots the gain of 1 lamb in one week, for the 13 weeks before shearing was 1.9 lbs. The average gain after shearing was 2.8 lbs.

During the week of shearing the lambs made very small gains. The most rapid gains of any in the experiment were made during the period following the shearing. The results of this trial are apparently favorable to shearing when lambs are confined in warm quarters.

TEMPERATURE AS AFFECTING GAINS.

A study of the tables will reveal the fact that some influence outside and in spite of the food, to some extent controlled the gains. It has often been remarked by feeders that sheep feed better in a cold, than in an open winter. How potent this influence may be, or whether it is of sufficient importance to merit our consideration can be determined only by more extended observation. It will appear from the tables that there is a general falling off in gain, produced by the same quantity of food, during certain weeks. By comparing the outside temperature for the weeks showing a decreased gain or *vice versa*, it was noticed that a falling off in gain was quite generally accompanied by a rise in temperature, and an increased gain seemed to be quite generally accompanied by a fall in temperature. Diagram I illustrates this apparent relation between temperature and gain.

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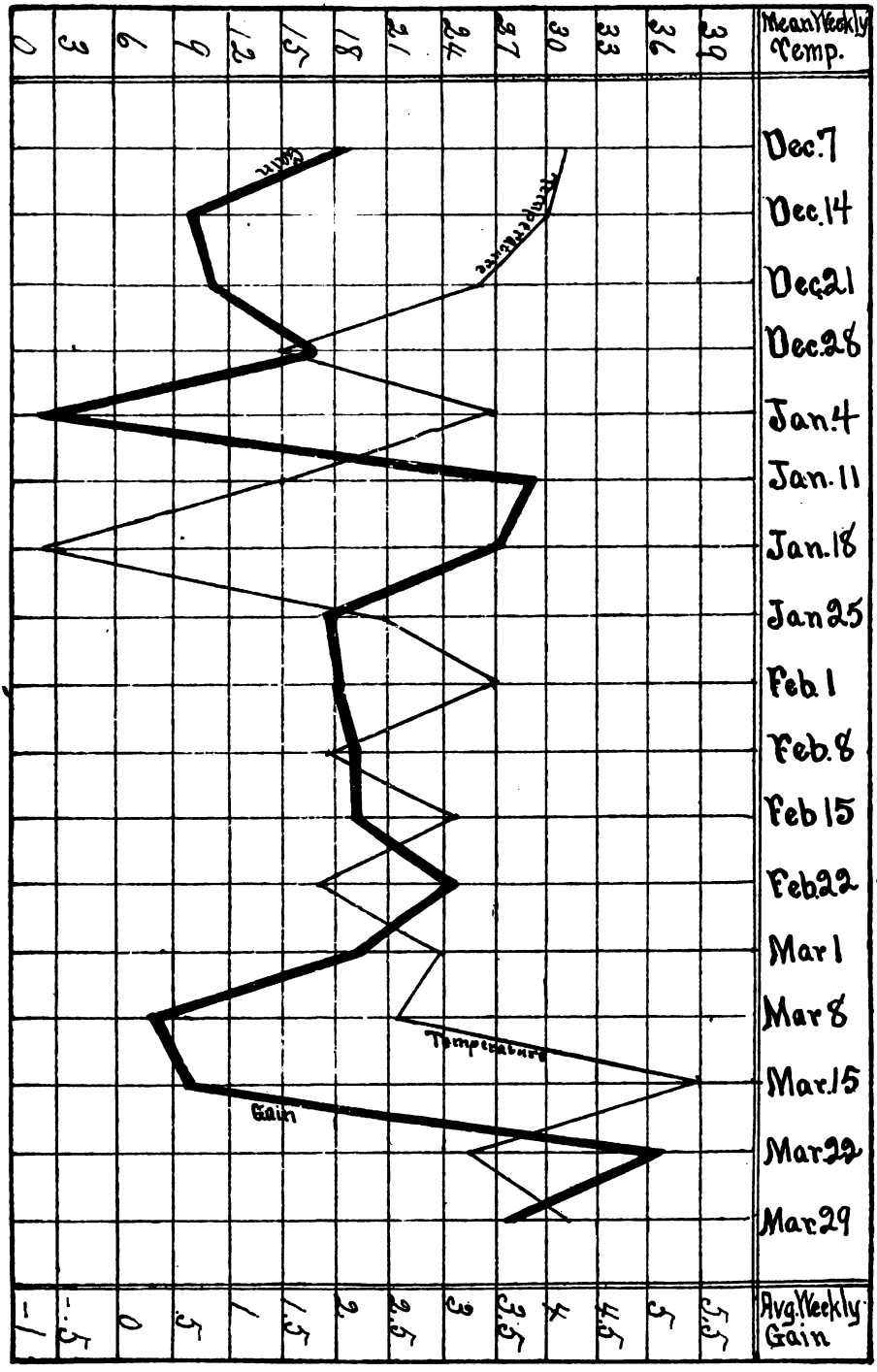

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The average gain by weeks is found by adding the average weekly gain of each lot and dividing by the number of lots. The temperature was compiled from the meteorological report of this station and represents the mean weekly temperature obtained from three daily observations. It will be noticed that in most cases the temperature and gain seem to vary together. Exceptions to this general tendency apparently exist in the weeks ending Dec. 14, Jan. 11, Mar. 8 and Mar. 15. The exception in the week ending Dec. 14 may possibly be accounted for by the fact that the lambs were all dipped on the 3d day of December, and the gains were in all probability somewhat influenced thereby. In the week ending Jan. 4, the lambs were all "off their feed," probably from over feeding, and hence the apparent influence of a rise in temperature is exaggerated.

Whether under different conditions, cold temperatures would be favorable to better gains or not remains to be further investigated.

COMPARISON OF FOODS WITH RESPECT TO COMPOSITION.

1. RELATION OF PROTEIN TO GAIN.

A great many experiments have been conducted with a view to determining the value of foods from their chemical composition. An exhaustive series of experiments by German chemists seemed to point to the conclusion that the content of available protein in a food stuff largely determined its feeding value. Many experiments in this country have given credence to this conclusion. Hence it has been taught that the gain depends upon the available protein in the food. The statement is comprehensive, and if true could not fail to be of the utmost practical importance. The experiments recorded in this bulletin were not planned with any reference whatever to the amount of available protein present in the different foods. The comparison was originally intended to be between different rations and their value for fattening lambs. The conditions were made as nearly identical for all the lots as possible with the exception of the kind and quantity of fodder articles. The results therefore should be an index of the comparative value of the rations fed, either because of the protein or other substances contained, or from the specific action of the rations themselves. To determine this point the available protein fed per day in each ration was calculated for each 1000 lbs. live weight. The calculations are made from the German tables and the average composition and digestibility assumed to be the same in the foods used, as those in the tables. To illustrate more clearly to the eye the relation of protein to gain we have prepared the following diagram.

At the top opposite the vertical lines are arranged the lots, while on the left side will be found the number of pounds of protein fed per day to a 1000 lbs. of sheep, live weight; similarly on the right are the average number of pounds gained per head, per week, in each of the lots, for the entire period. The lowest content of protein and the smallest gains are placed opposite at the bottom of the diagram and increase with regular increments toward the top of the diagram.

The heavy black line represents the gain and the lighter line the protein. If the gain depends upon the available protein in the food, the lines should be parallel, or at least tend in the same direction. It will be observed, however, that not only do the lines not run parallel but with few exceptions they tend in an exactly opposite direction.

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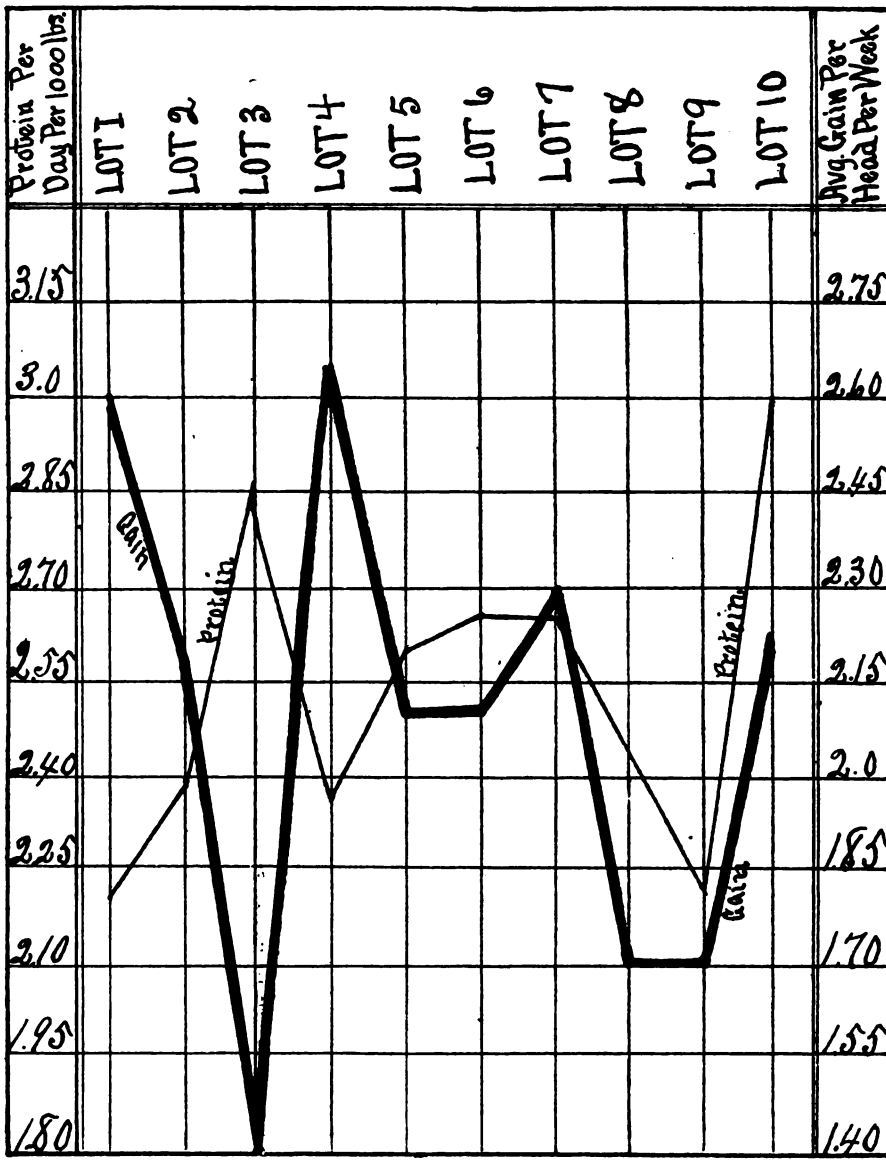
DIAGRAM 2. RELATION OF PROTEIN TO GAIN



Lot 1, which contained the least protein, made the greatest gain, and in lots 2 and 3 an increase of protein is accompanied by a decreased gain. This is true of all lots except 9 and 10 in which the gain seems to vary with the supply of protein. In lots 6 and 8 an increase in protein does not increase the gain accordingly. In lot 9 a marked decrease in protein has apparently no tendency to decrease the gain. It would seem there-

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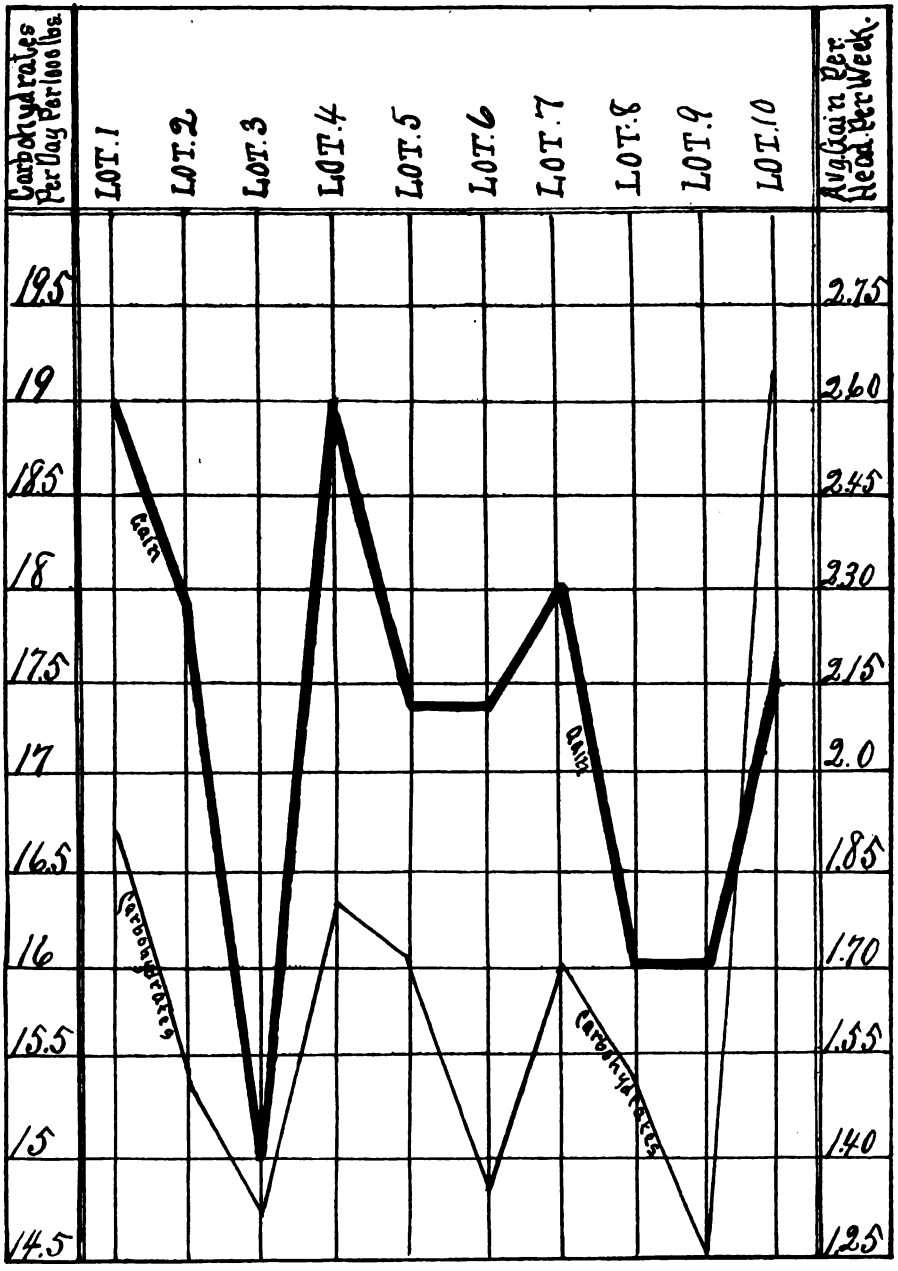
fore that we are justified in the inference that in this experiment some other and stronger influence than the supply of protein determined the gains.

DIAGRAM 3 RELATION OF CARBOHYDRATES TO GAIN.



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2. RELATION OF CARBOHYDRATES TO GAIN.

Let us study the results still further. The supply of carbohydrates in the fodder rations has often been regarded as of secondary importance. Diagram 2 is arranged precisely like diagram 1 except that the substances included under the term carbohydrates are inserted in place of protein. The diagram illustrates the relation of gain per week to pounds of carbohydrates fed daily per 1,000 lbs. of sheep live weight. The heavy black line represents the gains and the lighter line the carbohydrates. If it is true that the gains bear no direct relation to the supply of carbohydrates then the line should follow no general rule and we should expect more or less irregularity in their relations. It is noticeable, however, that the lines are apparently closely related and vary together. Commencing on the left we notice that a decrease of carbohydrates in lot 2 as compared with lot 1 is followed by a decreased gain; the same is true of lot 3; in lot 4 the increase in carbohydrates is marked, and the gain rises from 1.4 lbs. to 2.6 lbs. per week, and so on through each lot the relation between the supply of carbohydrates and the gain is apparently well defined. In only two cases is there an apparent exception; in lots 6 and 9 a decrease in the carbohydrates is not followed by a decreased gain. We are led to believe that the results obtained cannot be explained by mere coincidence. That ten lots of lambs comprising 125 individuals, fed under precisely similar conditions, except kind and amounts of fodder rations used, should by mere coincidence show such an intimate relation between gain and amount of carbohydrates eaten is scarcely probable. It is interesting at this point to call attention to an experiment by Lawes and Gilbert some years ago in which they investigate the "Comparative feeding value of different foods, according to their composition." One of their conclusions at that time was, "The comparative feeding value of our current stock foods depends more upon the proportion of the digestible non-nitrogenous substances (carbohydrates) they contain than upon their richness in nitrogenous compounds." Many other experiments in this country would also seem to indicate that under certain conditions the gain does not depend solely upon the available protein in the feed. It is possible that experimenters have confined their attention too closely to the consideration of the protein in feed to the exclusion of the carbohydrates. It is a fruitful field for observation and is at least worthy of more careful consideration than it has received.

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SUMMARY AND CONCLUSIONS.

1. Lots receiving corn in the grain ration, either in whole or in part, produced the best gains, were apparently in better finish, and in general were fed at a greater profit than the lots receiving bran or oats.

2. A grain ration of bran proved to be an inferior material for fattening lambs.

3. A ration of corn and oats produced slightly better results than either a mixture of corn and bran, or of corn, oats and bran.

4. The results of this experiment indicate that the gains resulting from fattening lambs by means of a "self feed," are produced by a larger consumption of grain for 1 pound of gain, than when fed at regular intervals in the usual manner, and other things being equal the gains are less profitable.

5. A mixture of fodder articles composed largely of a good quality of silage proved a cheap and successful ration for fattening lambs.

6. The rate of gain was apparently increased by shearing during the fattening period.

7. In this experiment colder temperatures were quite generally accompanied by increased gains.

8. The amount of available protein in the various rations was apparently a less potent factor in producing gains than the amount of available corbohydrates.

9. Small gains are not necessarily unprofitable nor are large gains a sure index of profitable food consumption.

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POTATOES AND THE POTATO SCAB.

BY L. R. TAFT AND R. J. CORYELL.

Bulletin No. 108.—Horticultural Department.

Potato raising is an industry in which the state of Michigan is largely interested, growing an annual crop of from ten to fifteen million bushels, with an average yield per acre, from 1880 to 1891, inclusive, of 91 bushels. For the same time the Detroit prices in car load lots averaged 45 cents per bushel.

Because of its importance, this station has given the potato crop a considerable amount of attention. The evident appreciation of our experiments by the potato raisers is a sufficient reason for some general suggestions that are here introduced.

The potato crop matures in a comparative short time, and to produce an abundant yield a large amount of plant food must be readily available—more in proportion to the quantity utilized by the plant than is required by any other farm crop raised in Michigan. Coarse manure or stiff sod, though they may contain an abundance of plant food, are unsuitable for the potato, as they decompose slowly, and the crop suffers because it cannot obtain a ready supply of nourishment. A lack of fertility or of moisture, especially at the time the tubers are developing, must seriously affect the yield, as the tubers make their entire growth in a period of from four to six weeks. But little substance is stored up in the vines for the future use of the tubers, and most of the material must come directly from the soil. Hence the necessity for having the manure well rotted, or the fertilizers soluble; of having the soil mellow and pulverized to allow the free and easy penetration of the roots to absorb the fertility, and of having a sufficient amount of moisture to dissolve the plant food.

During the summer a drought generally occurs, but thorough and repeated cultivation will do much to husband the moisture and carry the vines through this period. Should the drought be severe, or come when the tubers are developing rapidly, a shortened crop must be the result.

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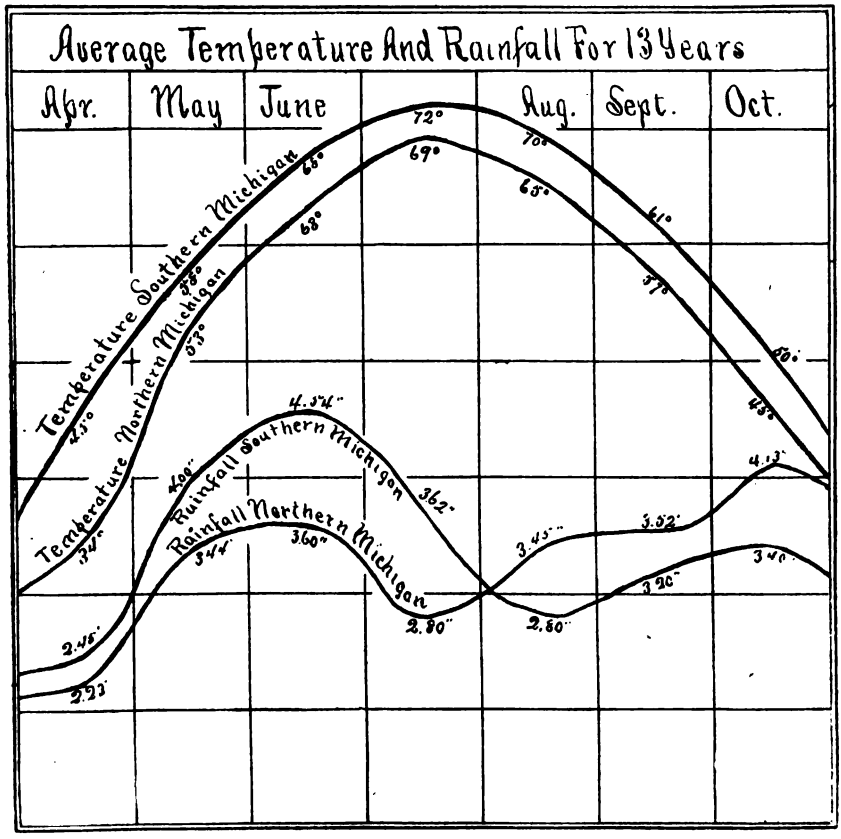
An examination of the rainfall record of the State shows that the drought comes regularly, although it varies in different parts of the State. With the view of determining the best date for planting, so that the tuber-forming period will not come at the time of the least rainfall, a table of

FIG. 1.—RAINFALL AND TEMPERATURE CHART.



rainfall and temperature is given. That portion of the State designated on the chart as *Southern Michigan* consists of the three southern tiers of counties. The part called *Northern Michigan* consists of those counties in the lower peninsula north of the southern line of Muskegon, Montcalm, Gratiot, Saginaw, Tuscola and Sanilac. The rainfall of the counties that border on the lakes is greater than in the interior. The counties on Lake Michigan have a greater rainfall than those on Lake Huron, while the Grand Traverse region is especially favored.

In the southern part of the State it is the general practice to plant potatoes after getting in the corn, or about the 20th of May. Potatoes planted at this time will form tubers in August, at the time of the least rainfall and the greatest heat, or under the most unfavorable conditions. If the planting is done either earlier or later it would be more favorable; if earlier, it should be done as early as possible, and it can be done early

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in April on many soils. The copious June rains will furnish abundant moisture at the time when most needed, even though the July precipitation be less than the normal. A medium early variety should be used in this case.

Generally, better results can be obtained by using the second alternative —planting later. By plowing early in May and keeping the ground well cultivated, the moisture from the spring rains can be retained, and an ideal seed bed secured. If we plant early in June, the ground being warm, the seed will vegetate quickly and the June rains will cause a rapid growth. The great need of moisture will not come until September, when there is an increase in precipitation and a lower temperature. That the late varieties of potatoes are better for this late planting, the results this year, in our variety tests, well illustrate. The planting was done from the 6th to the 8th of June, and while the drought killed the early varieties in from 58 to 65 days from planting and the crop was nearly a failure, the late varieties ripened in from 85 to 120 days, with a satisfactory yield.

In northern Michigan the drought comes in July, at a time when it will do the least harm to the potato grower. The line representing the rainfall for August and September, while not indicating a large precipitation, shows by its evenness that it is quite reliable. This condition with 5° to 8° lower temperature may in part explain why the northern portion of the State is so successful in potato growing. The average yield per acre in that part of the State is a fraction over 100 bushels per acre, while in southern Michigan it is about 82 bushels.

TESTS OF VARIETIES.

There were 174 varieties tested this season. The soil was a clay loam and for the previous two years was in strawberries. It was plowed in the fall, and in the spring about twenty-five loads of compost per acre were added and the land again plowed. The planting was done on the 6th, 7th and 8th of June. The manner of planting was as in previous years.

The growth was very vigorous until August 1, when began a period of two weeks of very dry weather, accompanied by strong hot winds. The early varieties were attacked by a leaf blight, which is treated briefly later on in this bulletin, and which, with the heat, killed many of them, so that the yield was unsatisfactory and consisted mostly of small potatoes. The drought affected the mid-season varieties to some extent, but the late varieties were only slightly, if at all, injured. The vines of many of the latter remained green until killed by frost on the 27th of September.

In examining the table, one must bear in mind the unfavorable conditions under which the early varieties were grown. The date of ripening, yield and cooking qualities were all affected. Many of the later varieties that show a large per cent of small tubers, would be quite desirable kinds in a more favorable season. Several of the varieties that were tried for the first time in 1892 have a poor average, although they gave large yields the past season. More credence should be given to the yield of 1893 than that of the previous year, for then the conditions were particularly unfavorable.

The "Manner of Growth" is indicated by the following abbreviations: "up" upright; "m" medium, "sp" spreading.

In the columns indicating the cooking qualities, the varieties are marked from 1 to 10. Below 7 is very poor, 7 poor, 8 fair, 9 good, 10 best. Many varieties stand low because of premature ripening.

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POTATOES, TABLE OF VARIETIES.

Variety.	Height of vines.	Manner of growth.	Date of maturity.	Yield.				No. of years for which the average is taken.	Cooking qualities.			Remarks.
				Large.	Small.	Total.	Average.		Flavor.	Dryness.	Color.	
Alaska	20	up	Sept. 20	59.8	22.9	82.8	149	5	8	7	10	
Albino	17	"	Aug. 16	52.2	48.2	100.4	126	4	8	8	9	
Alexander Prolific	24	sp	Sept. 30	139.8	35.6	175.4	175	1	10	8	9	
American Giant	14	"	" 24	80.1	41.4	121.5	121	1	9	7	8	Quite apt to be coarse.
American Wonder	28	up	" 23	353.8	51.8	405.6	224	2	9	8	9	Succeeding everywhere.
Arizona	22	m	" 25	117.4	90.1	207.5	132	4	10	10	9	
Badger State	18	sp	" 22	79.2	22.5	101.7	73	5	7	8	7	
Bannock	23	up	" 27	126.9	90.7	217.6	212	5	9	9	9	Reliable.
Barstow	24	m	" 1	107.5	82	189.5	170	2				
Beauty of Hebron	25	up	Aug. 26	174.2	72.1	246.3	175	5	9	8	9	
Bill Nye	24	"	Sept. 28	124.4	79.2	203.6	126	2	8	7	8	
J. G. Blaine	22	sp	" 4	91.2	60.5	151.8	117	2	8	8	7	
Blue Mayflower	26	up	" 20	108.5	44 2	153.8	121	2	8	8	9	
Boley Northern Spy	24	m	" 20	101.6	59.4	161	122	3				
Bonanza	26	up	" 5	225.2	55.4	280.6	160	2	10	9	9	
Boston	20	sp	" 20	60.5	61.6	122.1	120	2	10	9	8	
Brownell Best	24	up	" 26	116.4	98	214.4	175	4				
Brownell Winner	26	m	Oct. 5	129.8	57.1	186.9	160	4	8	9	8	
Burbank	23	m	Sept. 25	108.4	69.3	172.7	173	1	8	8	9	
Burpee Extra Early	19	sp	Aug. 12*	55	80.5	135.5	127	4	6	7	7	
Carpenter	14	m	Sept. 1	57.9	36.8	94.7	93	2	9	10	9	
Cayuga	26	sp	" 24	159.6	26.1	185.7	104	2				Tubers large, white, even size.
Chas. Downing	18	"	" 6	69.3	26.6	95.9	81	2	7	7	9	
Chautauqua	24	"	" 13	171.2	47.4	218.6	201	3	8	8	6	Very desirable. Tubers oblong, pink.
Chicago Market	20	"	" 10	99.5	65.3	164.8	165	1	9	9	9	Largely planted, lacks productiveness.
Clark No. 1	22	m	" 14	129.4	44.7	174.1	137	6	8	8	9	
College No. 67	23	"	" 20	135.6	52	187.6	103	2	8	9	9	
Columbian Rose	24	sp	Oct. 1	222.5	136.1	358.6	359	1	9	8	8	From V. D. Stoneroad, Lewiston, Pa.
Copper Mine	24	m	" 5	167.8	61.8	229.6	208	5	9	8	9	Reliable. Tubers pink, oval, flattened.
Cream City	18	up	Aug. 22*	57.9	42.1	100	115	2	10	9	10	
Cream of the Field	22	sp	Sept. 26	188.9	42.3	231.2	160	3	9	8	8	Very desirable. Tubers buff, oval.
Crown Jewell	25	"	" 1	125.9	44.5	170.4	177	3				
Dakota Red	25	up	Oct. 5	183.6	51.6	235.2	247	5	10	10	9	Very productive. Tubers coarse, poor color.
Delaware	24	sp	Sept. 25	126.3	37.4	163.7	140	3	10	9	10	
Early Harvest	25	"	" 1	89.5	142.8	232.3	193	5	9	9	9	Too many tubers for most years.

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Early Maine	21	up	Aug. 25*	96.8	81.6	178.4	140	5	7	8	8	
" May	24	m	" 18*	159	81.2	240.2	240	1				
" Mayflower	24	up	Sept. 18	127.8	48.1	175.9	132	8	8	9	8	
" Minnesota	24	sp	Aug. 8	102.8	94.4	197.2	182	8	7	7	9	
" Norther	22	"	Sept. 1	137.6	63.3	200.9	201	1	10	9	8	
" Oxford	24	sp	Aug. 15*	143.7	113.4	257.1	228	5	10	9	10	One of the very best early varieties.
" Pearl	26	up	Sept. 10	155.3	70.1	225.4	214	4	8	7	8	A good medium-season kind.
" Rose	28	sp	Aug. 24*	80.6	134.4	215	203	4	8	8	9	
" Six Week Market	20	up	" 6*	128	43	171	168	3	8	8	9	Best of the very early. Killed by heat.
" Sunrise	18	"	Sept. 1	78.8	52.9	131.7	132	1	9	9	9	
" Telephone	22	sp	" 25	101	84.7	185.7	186	1				
" Vermont	20	m	" 25	126.7	82	208.7	225	4	6	7	6	A good late variety.
" Wisconsin	24	up	Aug. 24	114.2	44.8	159	106	2	10	9	10	
Empire State	25	m	Oct. 5	176.2	35.3	211.5	196	5	10	9	8	
Everitt	24	sp	Sept. 20	92.6	77.1	169.7	193	4				
Excelsior	16	m	Aug. 8*	89.6	77.8	167.4	190	5	7	5	9	
Extra Keeper	20	sp	Sept. 20	47.6	38	85.6	86	1	7	7	9	
Farina	25	"	Aug. 26	85.4	120.3	205.7	144	3	10	10	9	
Fanats 1889	20	m	" 15*	38.4	91.6	125	164	3	8	7	8	Blights badly.
Fearnaught	26	up	Sept. 25	229.9	60.5	290.4	197	3	9	9	9	Tubers long, light colored, even size.
Feek Extra Early	13	m	Aug. 15*	128.9	49	177.9	161	3	8	8	9	
Fillbasket	24	sp	Sept. 10	154.9	86.5	241.4	174	2				Tubers light colored, oblong, flattened.
Ft. Collins No. 88	20	"	Aug. 18*	84.7	75.6	160.3	180	4	8	8	7	
Freeman	24	up	Sept. 20	171.4	57.6	229	216	3	10	9	10	Desirable.
Gardner's Early	16	m	Aug. 4*	42.9	98.3	141.2	148	5	9	8	9	Too easily affected by heat or blight.
Genesee Co. King	25	up	Sept. 28	166.4	108.6	275	192	2				Sets too heavy. Needs best conditions.
Gov. Rusk	25	m	" 20	190.3	51.7	242	182	2	8	8	7	Tubers oval, even size.
Green Mountain	24	up	" 25	149.6	52.1	201.7	132	4				
Gregory No. 1	24	sp	" 1	85.7	49.2	134.9	190	5	9	8	9	Reliable mid-season variety.
" " 2	21	"	" 22	113	58.8	171.8	149	4				
Halo of Dakota	26	up	" 25	268.6	25.8	294.4	241	3	10	10	8	One of the very best late varieties.
Hampden Beauty	24	m	Aug. 20	117.2	60.5	177.7	140	3	7	8	9	Blights badly.
Harbinger	21	up	Sept. 1	46.6	122.8	169.4	109	4	7	6	9	
Hicks No. 9	24	m	" 1	43.6	72.6	116.2	113	2	9	10	10	From D. C. Hicks, N. Clarendon, Vt.
" " 12	18	m	Aug. 16	109.5	89.5	199.3	192	2	8	6	8	A promising early variety.
" " 22	23	up	Sept. 10	131	75.7	206.7	143	2	8	8	9	
" " 81	27	m	" 18	218.6	34.4	253	196	2	7	7	9	Valuable, but tubers somewhat irregular.
" " 101	24	sp	" 25	223.2	35.3	258.5	196	2	9	9	8	Most desirable of his seedlings.
Hoadley	19	up	Aug. 16	59.4	73.4	132.8	112	2	8	9	9	
Hoffman	22	sp	Sept. 27	47.3	88.2	135.5	113	2	9	9	8	
Ideal	25	up	" 25	116.6	64.2	180.8	168	5	8	8	8	
Imperator	26	up	Oct. 5	207.3	100.2	307.5	178	4	9	8	9	
Ionia	28	sp	Sept. 15	79.1	38.4	117.5	80	3	7	6	8	
Iowa Beauty	16	"	Aug. 19	61	103.4	164.4	183	3	9	8	9	Blighted. Good color and form.
Iron Clad	25	"	Sept. 15	117.2	77.3	194.5	152	2	7	7	9	

* Killed by heat and blight.

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POTATOES, TABLE OF VARIETIES.—*Continued.*

Variety.	Height of vines.	Manner of growth.	Date of maturity.	Yield.				No. of years for which the average is taken.	Cooking qualities.			Remarks.
				Large.	Small.	Total.	Average.		Flavor.	Dryness.	Color.	
Joe Davis	25	up	Sept. 27	122	86.8	208.8	208	1	8	8	8	
June Eating	19	m	Aug. 9*	155	103.3	258.3	216	4				Desirable for first early.
Late Puritan	23	"	Sept. 24	111.3	55	166.3	122	2	10	9	10	
Lazell Seedling	24	"	" 30	139.8	35.6	175.4	211	3	8	8	9	
Leather Coat	18	"	" 1	100	58.5	158.5	185	4	10	10	9	
Lee Favorite	20	up	Aug. 23	66.5	95.2	161.7	210	5	10	10	9	Done poorly for last two seasons.
Mammoth Pearl	24	sp	Sept. 26	256	43	299	299	1	10	10	8	One of the best on the Farm Department.
Matchless	18	"	" 19	82.8	81.6	164.4	132	5	8	8	10	
McFadden Earliest	24	"	Aug. 10*	112	80	192.8	182	3	7	8	7	Desirable for early.
Minister	18	up	Sept. 11	38.7	60.5	99.2	96	4	9	9	8	
Minn. Seed No. 18	18	m	Aug. 8*	25.2	91.7	116.9	93	2	7	7	8	From S. Frogner, Herman, Minn.
" " " 50	25	up	Sept. 14	83.2	57	140.2	158	2	10	10	9	
" " " 64	24	m	" 1	80.4	136.8	236.2	147	2	8	7	8	Oblong, rose colored.
" " " 187	22	sp	" 20	90.9	59.9	150.8	110	2				
" " " 188	16	up	Aug. 20	57.8	43.1	105.9	180	2	8	8	10	
" " " 189	26	sp	" 28	162	42	204	166	2	10	9	10	
" " " 190	20	up	Sept. 7	124.8	61.2	186	165	2	9	9	8	
Mitchell Seedling	25	sp	" 25	178	68	246	176	3	10	10	10	
Monroe Seedling	26	up	" 25	132	79.2	211.2	206	3	7	7	10	Sets many tubers. Needs rich soil.
Morning Star	18	sp	" 4	65.2	110.5	175.7	149	3				
Mrs. Cleveland	20	"	Aug. 25	72.2	53.2	125.4	200	3	8	8	7	Blights this year. Generally prod
Mulla	25	"	Sept. 25	218.8	47.4	266.2	150	2	9	8	10	Promising. Tubers buff, round, u
New Queen	23	"	Aug. 16*	132.6	65.8	198.4	195	3	7	8	9	Valuable for early. Tubers white.
New Zealand	16	m	" 25	68.5	68.4	136.9	109	3	8	8	8	
Nott Victor	28	up	Sept. 12	233.9	59	292.9	208	3	9	9	9	Desirable. Tubers long, large, pink.
O. K. Mammoth	20	"	" 24	124.5	63.9	188.4	149	3	8	8	9	
Ohio, Jr.	22	"	Aug. 12*	43.8	100.2	144	119	3	8	8	8	
On Top	24	sp	Sept. 25	153	72.8	225.8	158	2	8	9	8	Tubers medium size, round, pink.
Osceola Mammoth	18	up	" 1	47	38.7	85.7	97	2	10	9	9	
Paris Rose	24	m	" 1	139.2	118	257.2	179	2	9	9	10	Valuable in moist, rich soil.
Park Region	24	up	" 10	125.5	65	190.5	190	1	9	9	10	Tubers large, buff, oval.
Peach Blow	28	"	Oct. 1	83.5	35.1	118.6	119	1	8	7	8	Worthless now.
Pearl of Savoy	25	"	Sept. 1	90.2	124	214.2	176	2	7	7	8	
Peoples	18	sp	" 15	65.9	60.5	126.4	126	2	7	6	8	
Perfection	22	up	" 1	59	86.7	145.7	163	3	7	7	8	

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Polaris	18	"	Aug. 16	68.8	81.2	150	140	6	9	9	9	
Pres. Lincoln	23	m	Sept. 30	158.5	78.3	236.8	224	5	8	8	8	Desirable in all points except color—red.
Putnam Beauty	22	sp	" 8	104.8	41.4	146.2	108	5	8	8	9	
" Early	18	m	Aug. 10*	37.5	118	155.5	204	5				Set too many tubers for this season.
" Select	24	up	Sept. 25	52.8	73	125.8	153	5	9	9	8	
Queen (New)	24	sp	Aug. 20	110.9	75.6	186.5	230	3	9	7	9	
Queen of Paris	24	up	Sept. 1	127.2	81.3	208.5	257	3	9	9	9	Heretofore has been our best variety.
Queen of the Valley	24	sp	" 1	100.8	80.7	181.5	146	4	8	8	8	
Randall Beauty	25	up	Aug. 14	61.7	141.2	202.9	176	5	7	6	7	
Red Star	26	m	Sept. 20	143.1	48.8	191.9	154	4	9	10	9	
Restaurant	24	sp	" 28	128.8	79.8	208.6	124	2	8	7	9	
Rochester Favorite	24	up	" 20	169.6	56.7	226.3	202	5	8	9	9	
Rogers Seedling	22	"	" 26	105.2	81.7	186.9	201	2	9	10	9	
Rose 74	24	"	" 22	114	27	141	184	3	9	9	10	
Rural Blush	22	m	" 1	127.5	129	256.5	224	4	7	8	8	Valuable for the richest soil.
Rural New Yorker No. 2	20	v up	" 22	135.7	83.6	219.3	139	4	8	7	9	Better than this record shows.
Salzer Earliest	22	up	Aug. 13	55.3	124.5	179.8	157	2	7	6	7	Sets too many tubers.
Seneca Beauty	22	sp	Oct. 1	154.8	56	210.8	211	1	9	10	9	Tubers red, oval.
Signal	23	m	Sept. 1	112.7	99.7	212.4	223	3	7	6	7	Valuable for mid-season.
Snow Queen	20	sp	" 10	63.7	122.9	186.6	136	3	8	8	9	
Stanley	22	up	" 1	195.6	67.8	263.4	173	2	9	8	8	
Star Russet	26	sp	" 25	101.3	83.2	184.5	154	3	8	8	9	
Stoneroad Main Crop No. 1	26	"	Oct. 1	136.1	30.3	166.4	166	1	9	8	7	Tubers uniform, light colored.
" " " " 2	24	"	Sept. 24	152	24.5	176.5	176	1				From V. D. Stoneroad.
Storr Seedling	26	"	Oct. 3	134	60	194	164	2	7	8	9	
Strong Alpha	14	up	Sept. 25	67.7	59.7	127.4	127	1	8	7	8	
Summit	27	m	" 20	189	61.7	250.7	264	4	9	8	9	Most productive variety here tested.
Sunlit Star	21	"	" 1	77.1	92.3	169.4	162	3	7	7	8	
Superior	26	up	" 20	74.9	57.1	132	153	4	9	8	9	
Supplanter	24	"	" 10	111.1	107.1	218.2	220	3	8	8	9	Tubers smaller than usual.
Sylvan	26	"	" 25	137.5	79.6	217.1	142	3	10	10	9	
Thorburn	28	"	" 24	188.4	115.7	304.1	224	5	10	10	9	One of the best. Needs good conditions.
Thunderbolt	26	m	" 25	162.6	59.3	222.9	140	3	9	10	9	
Timpes No. 2	26	up	" 26	106.6	65.7	169.3	156	3	8	8	7	
" " 4	22	m	" 22	112.6	53.4	166	186	3	8	7	9	
" " 5	24	up	" 1	132.1	132.6	264.7	173	3	8	9	8	
" " 6	24	sp	Aug. 24	120.6	56.4	177	167	3	7	8	8	
" " 9	24	up	Sept. 26	134.1	96.4	180.4	109	3	8	9	10	
Tonhocks	22	"	Aug 5*	93.1	90.3	183.4	191	3	7	7	9	
Umpire	23	"	Oct. 2	116.7	62.6	179.3	193	3	9	8	9	
Vanghan	23	sp	Sept. 16	99	49.5	148.5	148	1	9	8	8	
Vanghan White Prize	24	up	" 30	179.6	19.6	199.2	199	1	10	10	9	Tubers very uniform, light colored.
Vanguard	24	sp	" 2	191.6	39.7	231.3	149	2	8	7	8	A promising variety.
Vick Champion	23	"	Oct. 6	204.2	80	284.2	208	2	10	9	10	Tubers large, light colored, desirable.
" Early Market	26	up	Aug. 15*	151.8	42.4	194.2	194	1	8	8	8	

* Killed by heat and blight.

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POTATOES, TABLE OF VARIETIES.—*Continued.*

Variety.	Height of vines.	Manner of growth.	Date of maturity.	Yield.				No. of years for which the average is taken.	Cooking qualities.			Remarks.
				Large.	Small.	Total.	Average.		Flavor.	Dryness.	Color.	
Wall Orange	19	up	Sept. 26	108	95.4	203.4	140	3	...	...	...	
Watson Seedling	24	m	" 20	125.5	94.1	219.6	179	3	10	9	10	
Way	28	up	" 24	174.6	78.4	253	186	3	8	8	8	
West No. 1	20	sp	Aug. 14*	68.9	69.5	138.4	157	3	7	6	8	
" " 2	22	"	" 15*	105.9	73.2	179.1	100	3	6	5	5	
" " 3	20	up	" 25*	66.4	68.6	135	180	3	9	9	7	
White Beauty of Hebron	18	sp	Sept. 20	179.2	51.4	230.6	231	1	9	9	9	
White Chief	19	"	" 18	79.2	73.1	152.3	124	2	10	9	10	
White Elephant	24	up	Oct. 3	226.9	62.5	289.4	205	3	9	8	8	Still one of the best.
White Flower	28	"	Sept. 20	169.9	30.2	200.1	165	3	8	9	8	
White Star	24	"	" 26	79.5	90.5	170	162	3	9	10	9	
Wixom Seedling	22	sp	" 20	73.3	77.4	150.7	125	4	7	6	10	
Wolverine Beauty	24	up	" 25	178.4	28.9	207.6	207	1	9	10	10	
Woodbury White	27	"	" 26	231.1	73.1	304.2	304	1	10	10	9	
World's Fair	25	v sp	" 30	278.7	51.7	330.4	330	1	10	10	10	

* Killed by heat and blight.

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DESCRIPTIONS OF THE MORE PROMISING NEW VARIETIES.

Many varieties in the preceding table, tried by this department for the first time, were turned over by the Farm Department. They were treated in Bulletin No. 95.

Columbian Rose.—V. D. Stoneroad, Lewiston, Pa. This is a very promising variety. The vines are strong and vigorous, rather spreading. Tubers are medium size and uniform; form round and somewhat irregular; color rose.

Early May.—R. C. Barless, Rose, N. Y. An early variety of some promise. It did not reach maturity because of the drought and heat.

Stoneroad Main Crop Nos. 1 and 2.—These are seedlings from the above-named person. The vines are fairly good growers. The tubers are of good appearance, light colored, oblong with few shallow eyes. They resemble each other closely.

Early Norther.—V. D. Stoneroad. It was somewhat affected by leaf-blight, but it matured its crop. It is said to be a seedling of the *Early Rose*. In color it is darker than the parent, but about the same form. Season medium early.

Vaughan White Prize and *World's Fair.*—J. C. Vaughan, Chicago, Ill. These varieties are just alike in appearance and in season. They are medium size; skin netted; color much like the *Beauty of Hebron*; form round, irregular. The *World's Fair* is very productive.

Wolverine Beauty.—S. J. Youngman, Lakeview, Mich. A white, oblong, flattened potato, recommended as scab proof. They have very thick, russet skin. Only 8 per cent were scabby, which was a small number compared with many of the varieties.

VARIETIES RECOMMENDED.

The table shows very clearly the standing of the various varieties, but it may be desirable to give a short list here of the well tried sorts that are known to be reliable.

VERY EARLY.

Early Six Weeks' Market, Gardner Early and *June Eating.*

EARLY.

The following varieties are a little later than the previous class, better yielders and not so easily injured by adverse weather: *Early Oxford, Lee Favorite, McFadden Earliest, Queen, Paris Rose.*

MEDIUM.

Chautauqua, Early Pearl, Fillbasket, Freeman, Nott Victor, Queen of Paris, Signal, Supplanter, Rural Blush and *Thorburn.*

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LATE.

Those marked with an asterisk (*) are especially reliable: *American Wonder* *, *Bannock*, *Copper Mine*, *Dakota Red*, *Halo of Dakota**, *Hicks 81* and *101*, *Mulla*, *President Lincoln**, *Rochester Favorite*, *Rural New Yorker No. 2**, *Summit**, *Vick Champion*, *White Elephant* and *Woodbury White*.

POTATO SCAB.

Quite extensive experiments were carried on in seeking methods of checking this disease. It had already been quite thoroughly established that *corrosive sublimate* and *Bordeaux mixture* in the order named were the best fungicides with which to combat the scab. Our investigations were carried on for the purpose of finding the best strength and the proper length of time for soaking the seed.

In treating with corrosive sublimate, three strengths of the solution were used—1 part corrosive sublimate to 750 parts of water, 1 part to 1,000 and 1 part to 2,000. This is equal to 1 oz. of corrosive sublimate to nearly 6 gal. of water, 1 oz. to 7¾ gals. and 1 oz. to 15⅝ gals. The potatoes that were used for seed were soaked in these solutions for lengths of time varying from a few minutes to eight hours.

Two varieties of potatoes were used for each experiment—the O. K. Mammoth and the early Ohio. The seed of the former was very scabby (Fig. 2), so much so that the potatoes would not be salable. The scab spots on the Early Ohio were neither numerous nor deep enough to hurt their sale in any market. After the seed was removed from the solution it was placed in new paper bags, which prevented any contamination from crates or baskets.

The soil was a very uniform clay loam. It had been yearly cropped with garden vegetables for about twenty years, and received an annual dressing of compost for most of that time. No potatoes had been grown on it for at least six years, and probably longer.

The plots were arranged in sections which were two rods long and wide enough for fourteen rows of potatoes. For each row two pounds of seed were used, making twenty-five hills. Two rows in each plot were untreated. Next to these rows came the row that was treated for the shortest length of time, the arrangement of the rows in the field being the same as in the tables. The sections were placed end to end, and the cultivation was north and south, passing from one section to another. The planting was done on June 10.

FIELD PLAN OF THE SCAB EXPERIMENTS.

South.	1	2	3	4	5	6	7	North.
	O. K. Mammoth.	O. K. Mammoth.	Early Ohio.	O. K. Mammoth.	Early Ohio.	Bordeaux. Rural New Yorker No. 2.		
	1-750	1-1,000	1-1,000	1-2,000	1-2,000	1,000 lbs. fertilizer per acre.	2,000 lbs. fertilizer per acre.	

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FIG. 2. THE SEED USED IN THE TEST.

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FIG. 3. THE CROP FROM TREATED SEED.

FIG. 4. THE CROP FROM UNTREATED SEED.

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RESULTS WITH 1 TO 750 TREATMENT.

SECTION 1.

Variety.	Treatment.	Length of time in solution.	Yield per acre.	Per cent scabby.
O. K. Mammoth	untreated		137.5	54.3
Early Ohio	"		101.5	63
O. K. Mammoth	1-750	5 min.	108.3	9
" "	"	10 "	112	11
" "	"	¼ hour	96.8	10.5
" "	"	½ "	100	9.6
" "	"	¾ "	116.1	7.3
" "	"	1 "	122.2	5
" "	"	1¼ "	114.6	7
" "	"	1½ "	112	7.3
" "	"	1¾ "	129.4	7.6
" "	"	2 "	94	4
" "	"	2½ "	134.8	10
Average of the treated plots			112.7	8

No definite information was gained from this section except that the treatment was fairly successful, and that the seed treated the longer length of time was slower in sprouting.

RESULTS WITH 1-1,000 TREATMENT.

SECTION 2.

Variety.	Treatment.	Length of treatment.	Yield per acre.	Per cent scabby.
O. K. Mammoth	untreated		145	68
Early Ohio	"		97	68
O. K. Mammoth	1-1,000	¼ hour	159.1	8
" "	"	½ "	111.3	3
" "	"	¾ "	135.6	5
" "	"	1 "	103.3	4½
" "	"	1¼ "	118	10
" "	"	1½ "	134	2
" "	"	1¾ "	137	2
" "	"	2 "	102	3
" "	"	2¼ "	91.9	2
" "	"	2½ "	98	5
" "	"	3 "	102	5
" "	"	4 "	107	5
Average of the treated plots			116.6	4.5

SECTION 3.

Variety.	Treatment.	Length of treatment.	Yield per acre.	Per cent scabby.
O. K. Mam'oth	untreated		152.8	69
Early Ohio	"		139.7	69
" "	1-1,000	¼ hour	133.3	31
" "	"	½ "	152.8	34
" "	"	¾ "	126	34
" "	"	1 "	131	25
" "	"	1¼ "	157.8	13
" "	"	1½ "	124	7
" "	"	1¾ "	149.3	17
" "	"	2 "	143	17
" "	"	2¼ "	138.4	8
" "	"	2½ "	131.5	5
" "	"	3 "	108.2	3
" "	"	4 "	109.6	4
Average of the treated plots			133.7	16.5

A study of the treatment of the 1 to the 1,000 solution on the two varieties indicates three things,—that the scab decreases as the length of the treatment increases, as also does the yield, and that the *Early Ohio* is more subject to the scab than the *O. K. Mammoth*. The former has a thin skin, while the skin of the latter is very thick. It is possible that the thick skin prevents the entrance of the germs.

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RESULTS WITH 1-2,000 TREATMENT.

SECTION 4.

Variety.	Treatment.	Length of treatment.	Yield per acre.	Per cent scabby.
O. K. Mammoth	untreated	----------	72.5	34
" "	"	----------	106.3	32
" "	1-2,000	½ hour	110	4
" "	"	1 "	111.5	6
" "	"	1½ "	91.6	5
" "	"	2 "	99	3½
" "	"	2½ "	93.7	3
" "	"	3 "	105.2	2
" "	"	3½ "	102.5	1
" "	"	4 "	130	1
" "	"	5 "	106.6	2
" "	"	6 "	107.8	5
" "	"	8 "	149.8	1
Average of the treated plots			109.8	3

SECTION 5.

Variety.	Treatment.	Length of treatment.	Yield per acre.	Per cent scabby.
Early Ohio....	untreated	----------	126.3	76
" "	"	----------	114.7	68
" "	1-2,000	½ hour	139.4	11
" "	"	1 "	131.5	24
" "	"	1½ "	148.4	4
" "	"	2 "	123.6	15½
" "	"	2½ "	155.4	14
" "	"	3 "	116.5	7
" "	"	3½ "	112.5	14
" "	"	4 "	143.5	4
" "	"	5 "	129.1	7½
" "	"	6 "	154.8	3
" "	"	8 "	100.1	8
Average of the treated plots			136.8	11

The treatment with 1 to 2,000 gave the same results as the 1 to 1,000 solution. For purposes of comparison, the results obtained from Sections 2 and 3, and also Sections 4 and 5, are given in a condensed form in the following table:

SUMMARY OF RESULTS WITH DUPLICATE PLOTS.

SECTIONS 2 AND 3.

No. plots.	Treatment.	Length of Treatment.	Yield.	Per cent scabby.
4	untreated	----------	133.6	67.7
2	1-1,000	¼ hour	148.2	19.5
2	"	½ "	132	18.5
2	"	¾ "	130.8	19.5
2	"	1 "	117.1	15
2	"	1¼ "	137.9	11.5
2	"	1½ "	129	4.5
2	"	1¾ "	143.1	9.5
2	"	2 "	122.5	10
2	"	2¼ "	115.1	5
2	"	2½ "	114.7	5
2	"	3 "	105.1	4
2	"	4 "	108.3	4.5
Average of the treated plots..			125.1	10.5

SECTIONS 4 AND 5.

No. plots.	Treatment.	Length of Treatment.	Yield.	Per cent scabby.
4	untreated	----------	105	52.5
2	1-2,000	½ hour	124.7	7.5
2	"	1 "	121.5	20
2	"	1½ "	120	4.5
2	"	2 "	111.3	10
2	"	2½ "	124.5	8.5
2	"	3 "	110.8	4.5
2	"	3½ "	107.5	7.5
2	"	4 "	136.7	2.5
2	"	5 "	117.8	4.7
2	"	6 "	131 3	4.
2	"	8 "	150	4.5
Average of the treated plots..			123.3	7.1

There appeared to be as good results from the weaker solution as from the stronger. The per cent of scab on Sections 4 and 5 was less than on Sections 2 and 3 for the same length of immersion, but as the untreated plots had 15 per cent less scab it shows that it was probably outside influence that caused it. If the strengths used in these experiments for the time being be disregarded, the results of Sections 2, 3, 4 and 5 may be combined as follows:

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GENERAL SUMMARY.

AVERAGE OF SECTIONS 2, 3, 4 AND 5.

No. of Plots.	Length of Treatment.	Yield.	Per cent scabby.	Per cent scabby. 10 20 30 40 50 60
8	untreated	119.3	60.1	
6	¼ and ½ hour	134.3	15.2	
6	¾ " 1 "	123.1	18.2	
6	1¼ " 1½ "	129	6.8	
6	1¾ " 2 "	125.6	9.6	
6	2¼ " 2½ "	116.1	6.1	
4	3 "	108	4.3	
6	3½ and 4 "	117.5	4.8	

The final summary eliminates many of the accidental variations and as far as conclusions may be drawn from one year's work, it seems to show that the per cent of scab decreases as the length of time of immersion increases, but not in direct ratio. Those that were immersed an hour or less, have a comparatively large per cent of scab; when immersed over an hour, the amount of scab drops abruptly, as is shown in the above table for the one and one-quarter and one and one-half hour treatment. The per cent of scab here (6.8), being less than in the next series (9.6), shows that there is still a variation not yet eliminated. The longer immersions show that the scab decreases very slowly, and that for practical purposes one and one-half hour is sufficient.

Observe next the yields. There is an *increase* in yield of the treated plots over the untreated, but as the length of the treatment increases beyond one and one-half hours the *yield decreases*. Checking the scab seems to cause an increased growth, but when the seed is immersed two hours or more, the plants are so slow in starting that this increase is overcome.

The beneficial effect of the treatment is greater than is shown in the previous tables. The amount of scab on the tubers grown on the untreated plots was much greater than on the treated. On the latter the scab spots were mere pimples (Fig. 3), and not over one in ten showed even these. While on the former (Fig. 4) they were often as large as a twenty-five cent piece, and were formed upon more than half the tubers.

The diagrams show graphically the average results.

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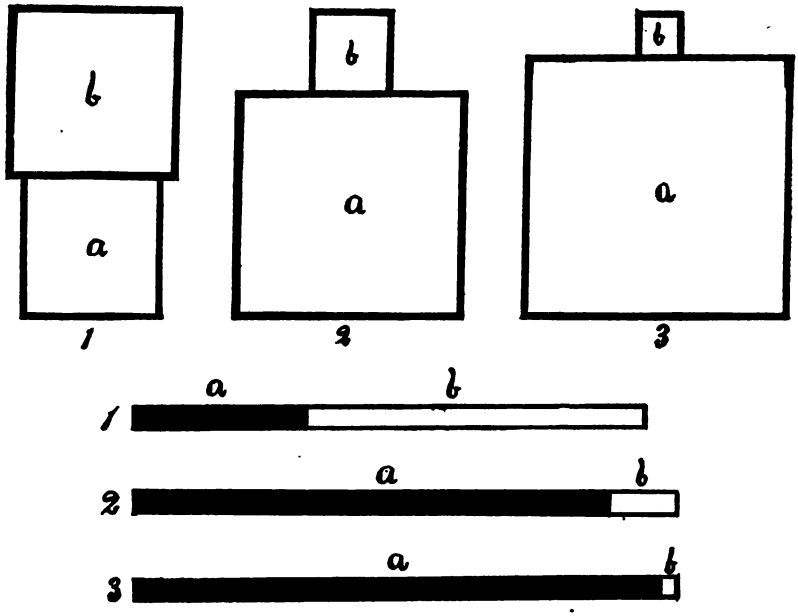
FIG. 5.—PER CENT AND AREA OF SCAB, TREATED AND UNTREATED.



1.—Untreated, (a) per cent free, (b) per cent scabby.
2.—Treated, (a) per cent free, (b) per cent scabby.
3.—(a) Area of scab on the untreated plots, (b) area of scab on the treated plots.
1.—Yield of the untreated plots, (a) free, (b) scabby.
2.—Yield of the treated plots, (a) free, (b) scabby.
3.—(a) Area of the scab on the untreated plots, (b) area of the scab on the treated plots.

A duplicate of this experiment was tried on land that grew a crop of potatoes in 1892. The soil was very uneven, and where the seed treated for a long length of time was planted it was low and moist. The scab and the yield increased as this lower ground was approached. There was much more scab in this duplicate experiment, showing that the germs from the previous crop remained in the soil and prevented the treatment from being a complete success, although the amount of scab was reduced one half.

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GENERAL SUMMARY OF THE CHECK PLOTS.

No. of plots.	Length of treatment.	Yield.	Per cent scabby.	Per cent scabby. 10 20 30 40 50
8	untreated	65.4	55.5	
6	¼ and ½ hour	85	18.1	
6	¾ " 1 "	73	22.9	
6	1¼ " 1½ hours	98.2	20.5	
6	1¾ " 2 "	90.6	24	
6	2¼ " 2½ "	107.6	30	
4	3 "	107.1	43.2	
6	3½ " 4 "	121.7	37.5	

EFFECT ON THE SOLUTION OF TREATING THE SEED.

A solution of corrosive sublimate was made and a sample taken for analysis. In the remainder, six lots of potatoes were soaked for two hours each, it being at the rate of one bushel of potatoes to one gallon of solution. A second sample was then taken. The two samples were analzyed by Prof. F. S. Kedzie, who found that the amount of corrosive sublimate was reduced from .92 parts to 1,000 of water to .36 parts to 1,000 of water, or from 1 part of corrosive sublimate to 1,087 parts of water before treating the seed to 1 part to 2,777 parts of water after treating.

Taking this as a basis, it would be advisable, after soaking about twelve bushels of potatoes in 15 gallons of solution, to add three-fourths of one ounce of the poison to the solution, so that the strength will not become too weak.

BORDEAUX MIXTURE FOR THE SCAB.

Rural New Yorker No. 2 potatoes were treated for the scab with Bordeaux mixture. The strength used was 4 pounds of sulphate of copper, 3 pounds of lime and 32 gallons of water.

Two plots were used, one containing 1,000 pounds of "Potato Grower" per acre and the other 2,000 pounds per acre.

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RESULTS WITH BORDEAUX MIXTURE FOR SCAB.

Length of treatment.	Fertilizer, 1,000 lbs. per acre.		Fertilizer, 2,000 lbs. per acre.		Average of the two plots.	
	Yield per acre.	Per cent scabby.	Yield per acre.	Per cent scabby.	Yield per acre.	Per cent scabby.
Untreated	200.7	41	152.7	56.5		
"	152.5	41.5	174.6	62	170.1	50.2
5 minutes	142.5	9	122.2	13	132.3	11
¼ hour	187.5	5	173.6	11	180.5	8
½ "	209.5	24.5	164.4	13	186.9	18.7
¾ "	176.4	15	174.2	7	175.3	11
1 "	181.4	11	165.7	15	148.5	13
1¼ "	165	8	183.3	4.5	174.1	6.2
1½ "	146.6	13	148	5	147.3	9
1¾ "	161.6	9	166.4	17	164	13.5
2 "	218.9	5	196.4	6	207.6	5.5
2½ "	184	10	200	10	192	10
3 "	180	19	201.6	7	190.5	13
3½ "	290	13	284.2	12	233.1	12.5
4 "	174	7	204.9	12	189.4	9.5
Average untreated	170.1	50.2				
" treated	178.1	10.8				

The Bordeaux mixture makes nearly as good a showing as the corrosive sublimate as far as the per cent of scabby tubers is concerned, but in the size of the scab spots there was no difference between those on the treated plots and those on the untreated, all being very small. Trials under more adverse conditions are necessary to establish its real value for this disease.

The above results seem to show that a treatment for a short length of time is as effective as the longer treatments. On the other hand there seems to be no injury to the tubers when soaked for long lengths of time.

CONCLUSIONS FROM THE SCAB EXPERIMENTS.

1. The potato scab can be readily and cheaply controlled.
2. Corrosive sublimate is the best remedy known as yet. Bordeaux mixture is promising.
3. Ground once infected with scab will retain the germs for several years and treating the seed for such ground will not be as effective.
4. The treatment causes not only a more salable product, but within proper limits an increased yield.
5. Corrosive sublimate, 1 part to 2,000, seems to be as effective as 1 part to 1,000. The latter strength is preferable as the solution gradually loses strength.
6. The best length of time to soak the seed is about one and one-half hours. A longer soaking may lessen the scab still more, but it reduces the yield.

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PRACTICAL SUGGESTIONS FOR TREATING FOR SCAB.

Use two ounces of corrosive sublimate to sixteen gallons of water. Dissolve the poison by first wetting it with an equal amount of water, stirring it until it is all made fine and is thoroughly wetted. If it is to be used at once, it should be turned into about two gallons of hot water to dissolve it quickly. *Never use metal dishes. Always take earthen or glassware, or wooden pails.*

For treating small quantities, barrels, half barrels or tubs may suffice. The tubers may be enclosed in a coarse sack and thus immersed, or they may be poured into the barrel, and, when ready to be removed, a burlap cloth can be stretched over the top of the barrel and the liquid strained into another vessel, and the potatoes dumped on the ground.

For treating larger quantities, a less laborious method would be to use a long and rather narrow box, or a watering trough can be used. The tubers can be taken out with a wire or perforated wooden scoop. The tubers should soak about one and one-half hours. After soaking three pecks of potatoes to each gallon of solution, if there are many more to treat, about three-eighths of the original amount of corrosive sublimate should be added, together with sufficient water to replace what has been wasted in removing the potatoes.

All wooden vessels that have contained the solution can be made suitable for general farm use again by washing thoroughly in clean water and then in water containing a little sal-soda.

Soak the potatoes when ready to cut the seed. Of the two operations the soaking should preferably be done first, although it is not necessary.

The expense of this treatment is very slight, consisting merely of the cost of the poison and the time of putting the potatoes in and taking them out of the solution. The operator may be employed the balance of the time in cutting seed.

Corrosive sublimate is worth about $1.00 per pound, and two ounces should not cost more than fifteen to twenty cents. For the accommodation of those who cannot obtain it readily, arrangements have been made with C. Alsdorf & Son, Lansing, who will send four ounces, post-paid, for twenty-five cents. It will be in one ounce packages, ready for use. The cash outlay for the treatment is about two cents per bushel at the outside.

This remedy was tried by hundreds of farmers the past season, and in no case, when it was properly used, has an unfavorable report been received. All seem well pleased with it, and one correspondent reports an increase in his crop of one hundred bushels of marketable potatoes per acre as a result of the treatment.

When such marked benefits can be obtained from so small an outlay, no potato grower can afford not to use this remedy.

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FERTILIZER TESTS.

In the tests of fertilizers upon potatoes, the same plots and the same fertilizers were used as heretofore. A continuation of these tests will show how well chemical fertilizers will keep up the fertility.

Each plot is one rod wide and four rods long, and contained three rows of potatoes. The rows are three feet apart and the remaining space is occupied by young pear trees. Four plots are in a row, and the fifth plot begins back by the side of the first plot. The fertilizers were applied both above and below the seed.

The planting was done on May 19 and 20. On the appearance of the vines considerable trouble was experienced from potato beetles, and the August drought reduced the yield to a noticeable degree.

The plots IIa, VIa and Xa were one square rod of the nothing plots of the previous years, fertilized this year by 1,000 pounds per acre of "Potato Grower" fertilizer, made by the Michigan Carbon Works, of Detroit.

FERTILIZER TESTS.

Plots.	Fertilizer.	How applied.	Yield per acre.—Bushels.						
			O. K. Mammoth.	Rochester Favorite.	Rural New Yorker No. 2.	Average yields.			
						1893.	1892.	1891.	For 3 years.
I	Mulch between rows		133	85.8	127.5	115.4	156.6	262.2	178
IIa	Potato grower	Under seed	179	229.1	196.6	201.6			
IIb	Nothing		53.8	45.8	74.3	58	102.6	166.9	109
III, IV	4 lbs. sulphate ammonia, 10 lbs. ground bone, 6 lbs. muriate potash	Under seed	78.2	141.1	179.5	133.9	130	221.2	168
		Over seed	86.8	53.7	77	55.8	133.6	196.3	128
V	Manure	Under seed	150.6	153.6	163.6	155.9	173.2	219	188
VIa	Potato grower	Over seed	113.3	196.5	173	160.6			
VIb	Nothing		54.6	47.9	72.8	58.3	73.1	170.6	101
VII, VIII	4 lbs. sulphate ammonia, 10 lbs. ground bone, 6 lbs. sulphate potash	Under seed	74.9	128.6	136.7	113.5	156.5	216.2	162
		Over seed	68.8	57.2	197.2	107.7	93.8	171.9	125
IX	1 bu. wood ashes		79	84.7	169.3	111	80.5	163	118
Xa	Potato grower	Under seed	255.1	220.6	227	234.2			
Xb	Nothing		77.2	124.3	113.5	105	54.8	172.2	111
XI, XII	6 lbs. nitrate soda, 10 lbs. ground bone, 6 lbs. sulphate potash	Under seed	103.4	161.1	217.2	159.9	96	184.9	147
		Over seed	107.8	132	189.4	126.4	96.5	143.1	122
XIII	Manure	Over seed	111.3	126	158.9	132.1	105.9	188.8	142
XIV	Nothing		83.8	125.8	115.9	108.5	51.3	128.9	96
XV, XVI	10 lbs. ground bone, 6 lbs. sulphate potash	Under seed	134.2	134.1	187.9	135.4	150	231	172
		Over seed	162.7	197.7	185.9	182.1	156	199.3	179
XVII	Nothing		70.3	92.4	93.6	86	45.5	115.4	82
XVIII	6 lbs. sulphate potash	Under seed	58.8	160.5	108.9	109.4	64.7	194.4	123
XIX	6 " " "	Over seed	84.7	179.6	179.9	148.1	47.9	190.4	129
XX	6 lbs. nitrate soda, 10 lbs. ground bone, 6 lbs. muriate potash	Under seed	120.4	237.9	221.1	193.1	114.1	186	164

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In examining the yields, attention is called to the fact that each row contains a nothing plot. The yields of these nothing plots vary somewhat, but as the soil in each tree row is quite uniform the nothing plot of that row should be used as a base of comparison for the plots of that row.

The following table shows the gains of the fertilized plots over the nothing plots, and it should be used in determining the relative value of the fertilizer in the different rows.

GAIN PER ACRE FROM THE USE OF FERTILIZERS.

Plot.	Gain in bushels.				Gain illustrated. 20 40 60 80	Fertilizer.
	1893.	1892.	1891.	Av. 3 years.		
I	57.4	54	95.7	69		Manure.
V	97.6	100.1	48.4	82		
XIII	23.6	54.6	59.9	46		
III	74.9	27.4	54.3	52.2		Complete fertilizer.
IV	2.2	30	29.4	19.1		
VII	55.2	83.4	45.6	61.4		
VIII	49.4	20.7	1.8	23.8		
XI	54.9	41.2	12.7	36.3		
XII	21.4	41.7	29.1	11.3		
XX	107	68.5	70.6	82		
XV	26	98.7	102.1	75.6		Ground bone and potash.
XVI	73.6	104.7	70.4	82.9		
IX	6	25.7	9	7.6		Ashes.
XVIII	23.3	19.2	84	42.2		Potash.
XIX	62	2.4	75	46.5		

It should be noted that in plots IV, VIII, XII and XIII, where the gain was comparatively small, the fertilizers were applied over the seed and the difference was without doubt due to the lack of moisture to dissolve them.

The results of this, the third year of the experiment, are very much like those of last year. The most noticeable change is that the plots with commercial fertilizers are decreasing in yield rapidly while the manure plots show but a small decrease.

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The use of commercial fertilizers for potatoes is advisable when the soil lacks fertility, and well composted manure is not available. Good preparation of the soil is necessary to secure an increase of crop sufficient to pay the additional cost of the fertilizer.

LEAF-BLIGHT OF THE POTATO.

A bacterial disease, has been quite injurious at the college for several years. It appears during the hot, dry weather and is especially severe on those varieties that are at that time half grown. In 1892 the mid-season varieties and the early kinds escaped. This season, it was the opposite, but in both cases it was the most injurious upon those varieties that had reached a certain stage of growth, when the heat and drought became severe.

Vines killed by the leaf-blight are readily distinguished from those killed by the drought. In the former case the leaf turns black at or near the tip. This blackened area increases until in about a week one-half to three-fourths of the leaf surface is affected. At this stage if the weather continues unfavorable the drought aids in killing the weakened vines. Vines killed by heat and dry weather lack the discolored leaflets, and the leaf stems and small branches hang pendant on the upright stalks. The only remedy is to fight the drought.

AGRICULTURAL COLLEGE,
February 1, 1894.

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VARIETY TESTS OF VEGETABLES.

BY L. R. TAFT.

Bulletin No. 109.—Horticultural Department.

For several years it has been the custom of this department to make careful tests of the varieties of vegetables sent out by the different dealers as novelties, and to issue the results in bulletin form at the end of the season. Many of these so-called new sorts are sold at prices much above those of standard varieties, but although highly praised by the introducers, are not always worthy. On the other hand, they are often greatly improved strains of some of the old and valuable sorts or new and distinct varieties of marked merit, and would then be desirable acquisitions.

The purchaser can only determine their value by actual trial, and for any one person to purchase and grow all the highly praised varieties sent out in a single season will require a large expense in money and time. The experiment station can do this work and the reports of the results of the trials will be of value to every one who purchases garden seeds. It must be admitted, however, that in many cases we are one year behind the time, but the grower will have the report for use the next year and by that time the cost will be reduced so that a start can be obtained with a smaller outlay. It is desirable, and the seedsmen are each year doing it more and more, that promising novelties be submitted for trial, to some half dozen experiment stations in different parts of the country, who make a specialty of testing varieties, the year before they are catalogued. Before a seedsman takes up a novelty he generally tests it for at least one season upon his own trial grounds, and if, when he obtains a sample of a variety which he proposes to introduce should it upon trial prove desirable, he would send a sufficient amount to some of the experiment stations, or require the originator to do so, not only might it save the public from loss should it be inferior, but, if it has real merit, a report to that effect by the stations

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would both increase the sales of the dealer and assure the public that the variety has value.

In the course of our variety tests we have had frequent occasion to ascertain the character of the seeds sold by different dealers, both as to vitality and the value of the strains, and we believe that most of them are doing what they can to keep their seeds up to a high standard. We find that as a rule far better results are obtained when the seeds are ordered direct from the dealers, rather than purchased as box or bulk seeds of a grocer; but, however reliable a seedsman may be, it will always be found safest to test the vitality of the seeds before putting in the crop. Seeds of low germinating power are occasionally sent out by all dealers, unwittingly oftentimes, and a few minutes spent in testing the seeds may save one from serious pecuniary, as well as a vexatious loss.

The tests of the cabbages, cauliflower, sweet corn and peas have been under the charge of my assistant, Mr. R. J. Coryell, and the report was prepared by him, while Mr. H. P. Gladden has looked after the beans, celery, cucumbers, lettuce, salsify, squashes and tomatoes, and has prepared the appended notes. Quite a variety of other vegetables were grown, but in very few of them were there any novelties that have been found better than the old sorts.

The seeds used in the tests were obtained from the following firms: Robert Buist, Jr., Philadelphia, Pa.; Atlee Burpee & Co., Philadelphia, Pa.; Currie Bros., Milwaukee, Wis.; D. M. Ferry & Co., Detroit, Mich.; J. J. H. Gregory, Marblehead, Mass.; Peter Henderson & Co., New York; D. Landreth & Sons, Philadelphia, Pa.; A. W. Livingston's Sons, Columbus, Ohio; W. H. Maule & Co., Philadelphia, Pa.; A. M. Nichol, Granville, Ohio; W. W. Rawson, Boston, Mass.; John A. Salzer, La Crosse, Wis.; J. M. Thorburn & Co., New York City, and J. C. Vaughan, Chicago, Ill.

CABBAGE.

R. J. CORYELL.

The forty-eight varieties tested this year included nearly all of the new sorts listed by the seedsmen, and some of the standard kinds for comparison. The seeds were sown in the forcing house on March 20. The plants were transplanted into flats on April 8 and set in the field May 16.

The severity of the drought, which extended from July 16 to well into September, was so great that the test was a failure in that many kinds headed out of season. The test was of value since it showed clearly those kinds that would produce a good crop under adverse conditions. The earliest varieties were not affected, the injury being most severe on those that mature at midseason or later. Of these the larger kinds, or those that have many leaves, suffered most. The medium-sized varieties that had but few outside leaves were generally uniform in heading and produced a fair crop.

Of the early varieties the *Etampes*, Currie, and *Lightning*, Salzer, were the first to head. The latter, a strain of the Wakefield, produced very even, solid heads. The *Charleston Wakefield*, Henderson, was a day or so later and enough larger to make up the difference in time. *Eclipse*, Currie, advertised as a second early variety, matured with the *Charleston*

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Wakefield. The type did not appear to be fixed, but a good crop was produced. Following these kinds within a week are several larger varieties. *Henderson's Early Summer*, Ferry, proved to be an excellent strain of that well-known sort. *Ideal*, Salzer, was much like it and as good. *Bloomsdale Early Market*, Landreth, and *Early Flat Dutch*, Ferry, were of the same season as the preceding kinds, but not so good.

Of the mid-season sorts, *All Seasons*, Ferry, followed closely the second early kinds. Every plant produced a salable head. It is a strain of the *Flat Dutch* and will be found a reliable variety.

Succession, Ferry, was four days later than *All Seasons* and much like it, maturing in eighty-six days from the time of setting in the field. It was the best variety of this class and in fact the best of any planted this year. The heads were of medium size, solid and uniform. The stump was short and leaves few. *Reynolds*, Maule, and *Fottler's Early Drumhead*, Ferry, were a few days later than *Succession*. They produced uniformly good heads.

All the late cabbages did poorly. *Autumn King*, Henderson, and *World Beater*, Burpee, are similar in growth and appearance. *Safe Crop*, Burpee, did fairly well. *Large Late Mountain*, Landreth, resembles the preceding variety closely. Fewer plants headed, but those that did were much better.

CAULIFLOWER.

Eleven varieties were tried. They were treated nearly the same as the cabbages, being planted and cultivated on the same dates, but were given richer soil. The drought affected them as it did the cabbages, causing a failure of the later maturing varieties.

Of the earlier varieties, the *Snowball*, Ferry, *Dwarf Erfurt*, Ferry, and *Sea Foam*, Rawson, were the best in the order named.

Mont Blanc, Buist, made a good showing. The head is well protected by leaves, which is an advantage to it. *Autumn Giant*, Vaughan, was much like this variety but it did not do as well.

SWEET CORN.

Each variety of sweet corn occupied a row 100 feet long, except in a few cases where the amount of seed was too limited. The rows were four feet apart and the hills in the row were put at a greater or less distance according to its growth. The planting was done on May 25. Five kernels were placed in a hill and afterwards thinned to four stalks. Many kernels did not germinate and the varieties did not average more than three stalks per hill. All varieties grew well until the hot winds and drought came during the first part of August, which affected all except the earliest varieties. The frost injured a few of the later kinds.

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TABLE No. 1.—VARIETY TEST OF SWEET CORN.

Variety.	Seedsman.	Distance between hills as planted.	Distance between hills recommended.	No. days to market maturity.	Height of stalks in feet.	No. of stalks.	Av. No. of ears per stalk.	Av. weight of ears in ounces.	Av. length of ears in inches.	No. rows of kernels.	Yield per Acre. No. pounds per acre. No. ears per acre. 2,000 4,000 6,000 8,000 10,000 12,000 14,000 16,000 18,000 20,000 22,000 24,000
Cory	Ferry	2½	2½	67	3	105	1.11	5.3	5	8	
White Cob Cory	"	2½	2½	67	3	102	1.12	6.2	5	8	
Eastman Early	Hicks	2½	2½	70	3	33	1.15	5.6	5	8	
First of All	Maule	2½	2½	70	3½	96	1.27	5.6	5	8	
Early Maine	Vaughan	2½	2½	71	3½	121	.75	5	6	8	
La Crosse	Salzer	2½	2½	71	3¼	119	1.14	5.6	7	8	
Ex. Ey. Vermont	Hicks	2½	2½	72	2¾	68	1.42	7.1	6	8	
Northern Pedigree	Ferry	3	2½	73	3	49	1.24	5.2	5	8	
Chicago Market	Buist	3	3	74	5	68	1.22	7.1	6	12	
Perry Hybrid	Ferry	3	3	74	5	73	.97	8.3	7	12	
Leets Early	"	3	3	76	4	77	.81	7	7	12	
Crosby	"	2½	3	76	4	85	.96	6.3	5	10	
Early Champion	Vaughan	2½	3	76	4	114	.91	6.7	5	12	
Early Minnesota	Ferry	3	3	78	5	93	.86	6.1	6	12	
New Eclipse	Hicks	2½	2½	78	2½	21	1.19	4.8	5	8	
Concord	Ferry	3½	3½	79	5½	98	.58	7.6	5	14	
Perkins Early Market	Buist	2½	3½	81	5½	127	.79	9.8	8	8	
Golden Nugget	Gregory	4	3½	82	4	44	1.25	7.6	6	10	

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Fee and Kay	Ferry	3	8	88	4½	82	.76	9.8	6	12	
Mexican	"	3½	3½	88	4	21	.90	7.5	7	8	
Stabler Early	Buist	3	3	85	3½	87	1.19	13	8	12	
Hickox Hybrid	Ferry	3½	3½	85	5½	73	1.26	7.3	6	8	
Nonesuch	Manle	3	4	86	6	68	.97	9.8	6	10	
Egyptian	Ferry	4	4	88	6½	70	1.44	9	7	14	
Ne Plus Ultra	Buist	3½	3½	90	4½	44	1.73	8.1	6	12	
Stowell Evergreen	Ferry	4	4	90	5¾	55	1.02	12.	7	16	
Squantum	Henderson	4	3½	91	5½	77	.78	7.3	6	10	
Stabler Pedigree	Buist	3	3½	95	6	51	.96	9.3	7	10	
Old Colony	Ferry	3	3½	95	5	84	.52	8.2	5	16	
Gold Coin	Vaughan	4	3½	96	5	41	1.27	9.6	6	14	
Triumph	Buist	4	3½	96	4	88	1.16	10	7	8	
Zigzag	Northrup, B. & G. Co.	2½	4	96	6¼	105	.69	8	5	12	
Country Gentleman	Henderson	4	4	102	6¼	53	1.35	8.1	6	14	

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When the ears had reached the edible stage, all except those upon four or five hills were gathered, counted and weighed. Those that remained were allowed to mature and were then counted and their weight estimated to be the same as the others. This formed the data for determining the yield as shown in the table. In computing the yield per acre, four stalks were reckoned per hill, which was not the actual case, but it gave a fairer estimate of the value of that variety than had the actual number of stalks been used.

The distance apart that each variety should be planted was carefully studied and the one recommended as well as the distance actually used this year is given in the table. This point may be of value to some in making the most economical use of their land when sweet corn is grown in large quantities. Many varieties would do better by being planted less than four feet apart in rows and at a greater distance between the hills than is recommended in the table.

The following are new varieties:

Eastman Early.—D. C. Hicks, North Clarendon, Vt. A variety similar in growth and in ear to the *Cory* The ears are not quite so regular nor as even in size as that variety and the kernels are more wrinkled than any of the early varieties, while the cob is variable in color from white to pink.

Extra Early Vermont.—Hicks. This is the most prolific variety among the early kinds. While excelled by the *Cory* and *White Cob Cory* in earliness, its productiveness makes it valuable. It set at least two ears per stalk and matured this year with us an average of one and one-half ears. The type is not yet fixed, the cobs varying from white to red; ears slim, of fair length and well filled.

Early Champion.—Vaughan. This variety follows the first early kinds within ten days. The ears were of good diameter, but were very short this year, while the plants lacked productiveness.

New Eclipse.—Hicks. An eight-rowed variety having the same characteristics as the *Cory*, but maturing later. While setting a sufficient number of ears, they were very small and poorly filled.

Zigzag.—Northrup, Braslan & Goodwin Co. This is a late variety covering a long season. There is little or no difference between it and *Country Gentleman.*

The following varieties are recommended:

EARLY.

White Cob Cory, Extra Early Vermont, Chicago Market and *Stabler Early.*

MIDSEASON.

Egyptian and *Nonesuch.*

LATE.

Gold Coin and *Country Gentleman.*

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PEAS.

Fifty-six varieties were tested. These included most of the new varieties and many standard sorts. Considerable attention was paid to classifying the varieties. Those that were known to be of the same season and the same manner of growth were planted close together for convenience in comparison.

On May 10 the seeds were sown, two hundred seeds of each variety being planted in double rows ten feet long. After the vines were well up, all but one hundred were removed and the remaining vines were supported by a woven wire trellis. The season was favorable for a good test, although the hot weather hastened the maturity of the late varieties.

When the pods were in an edible condition, they were picked and the data for the last three columns of the table were obtained from them.

Among the smooth, white, early varieties there is but little choice. The *Bergen Fleetwing* was the most prolific, but the pods were small. *Maud S* and *Extra Early* had the best filled pods. In earliness, there appeared to be no choice.

Following these varieties very closely are several blue peas. Although edible in from forty-nine to fifty-one days, they were about four days behind the first early kinds in market maturity and in ripening.

Between the *Alaska*, *Clipper* and *Lightning* there appeared to be no difference. Of these the table shows the *Clipper* to be the best, although, as they grew, no choice was noted. Of these second early peas the *Blue Beauty* easily stands at the head. It is a dwarf, stocky grower, productive of medium sized well-filled pods. *Universal*, a new variety of dwarf habit, is fairly promising. The pods are small and rather variable. *Chelsea* differs from the *Premium Gem* in the color of the peas and slightly in the appearance of the leaves. *McLean's Little Gem* belongs in this season. The pods are of good size and the peas are of good quality. It is well known and planted everywhere. *Kentish Invicta* is a very prolific variety, but its pods ran very small at the last. *Wm. Hurst* withstood the hot weather well. The pods were crisp and the peas were very sweet, but the vine was unproductive.

Exonian, a new kind imported into this country, is a day or so later than the above varieties. It is fairly promising, but did not withstand the heat as did the native sorts. *Early May*, a new variety, was said to be as early as the *American Wonder*, but it was much later. The pods are mostly borne profusely in pairs, and all reach maturity nearly at the same time. It fills the season very nicely between the second early and the mid-season kinds. *Petit Pois* is a new variety introduced from France as of the highest quality. The vines are slim, medium tall, and very productive of rather small but closely filled pods. The peas are very delicious until full grown, when they rapidly harden. *Profusion* is a good variety for this season; its pods ran rather small at the last picking.

Following these varieties come those that are known as the mid-season kinds, most of which have larger pods than those preceding. Among these varieties there are a large number that are so nearly alike in growth, pod and season, that if a grower had one of them he would not need any of the others.

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Belonging in one class are the *Stratagem, Juno, Stanley, Shropshire Hero, Pride of the Market, Gladiator* and *Heroine.* These have strong, stocky vines about two and one-half feet high, and bear medium large, thick, well-filled pods that are slightly recurved. The pods are borne near the extremity of the vines and reach maturity nearly at the same time. Also covering the same season are the *Abundance, Bliss Everbearing, Blue Imperial* and *Yorkshire Hero.* These varieties have smaller, broader, flatter and more pointed pods than the *Stratagem* class. These differ from each other in season slightly. The *Yorkshire Hero* is a little later and the *Blue Imperial* is slightly earlier than the *Bliss Everbearing.*

The *Telegraph, Long Island Mammoth* and *Evolution* are varieties of medium tall, slim growth that cover a longer season than the preceding mid-season varieties. Their season begins with the *Stratagem* class and extends several days later. This is especially true of the *Long Island Mammoth,* from which edible peas could be picked for a period of eighteen days. *Fill Basket* resembles these varieties in the shape of its pods, but the vines are shorter and more stocky. It covers a long season and was the most productive variety of the mid-season sorts.

The *Duke of Albany* and *American Champion* are alike in every respect. Vines are tall and pods large. The pods of the former were not always well filled. They cover the same season as the *Evolution* class.

Eugenie, a new dwarf variety that follows the *Stratagem* class in a few days, is very productive. Pods medium large, well filled. *Dwarf Telephone* is a short, stocky variety with large, long pods like those of the *Telephone,* but it is more productive. In season it is about two days later than that variety. *Sutton Satisfaction* is a new late variety, very branching and very prolific if planted thinly.

Melting Sugar and *Tall Sugar* are two varieties with edible pods. The former is in season just before the *Stratagem,* while the latter follows the *Champion of England.* They are very tender and all parts cook nicely except the ventral suture, which remains stringy.

Best varieties for planting:

EARLY.

Extra Early or *Maud S.*

SECOND EARLY.

Blue Beauty, Early May.

MID-SEASON.

Fill Basket, Heroine, Eugenie.

LATE.

Sutton Satisfaction, Champion of England.

The following new varieties are promising:

Dwarf No. 2, Universal, Exonian, Early May, American Champion, Dwarf Telephone, Eugenie, Sutton Satisfaction.

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TABLE No. 2.—VARIETY TESTS OF PEAS.

VARIETIES. Arranged in order of their maturity.	Seedsmen.	Per cent of germination.	Height of vines.	No. days to edible maturity.	No. pods per 100 vines.	Average No. peas per pod.	Per cent of peas to total weight.	Yield in ounces from 100 vines.	Yield of 100 Vines in Ounces.
Bergen Fleetwing	Gregory	73	2	48	526	4.1	59	72.7	
Burpee Best	Burpee	59	2	48	465	5	57	64.6	
Challenge	Currie	78	1¾	48	398	6	48	61.3	
Extra Early	Ferry	74	1½	48	443	7	46	62.9	
Hancock	Gregory	79	1¾	48	440	5.6	51	62.5	
Morning Star	Buist	74	1¾	48	396	5	53	59.4	
Maud S.	"	61	1½	48	396	7	49	64.9	
Bergen X American Wonder	College	62	2	48	492	5.2	50	72	
Dwarf No. 2	Hicks	100	1¼	48	326	5.7	55	69.1	
Dwarf No. 4	"	92	1½	48	350	4.25	60	49.7	
Alaska	Ferry	79	2¾	49	380	6.25	58	64.4	
Clipper	Rawson	80	2½	49	484	6	47	78.4	
Lightning	Dreer	45	2½	49	435	5	66	66.9	
Alpha	Ferry	50	2½	49	380	6.25	64.4	58	
American Wonder	"	49	1	50	344	6	63.3	62	
Blue Beauty	Buist	28	1½	50	803	5.3	47	134.9	
Chelsea	Henderson	59	1½	50	405	5.6	56	79.4	

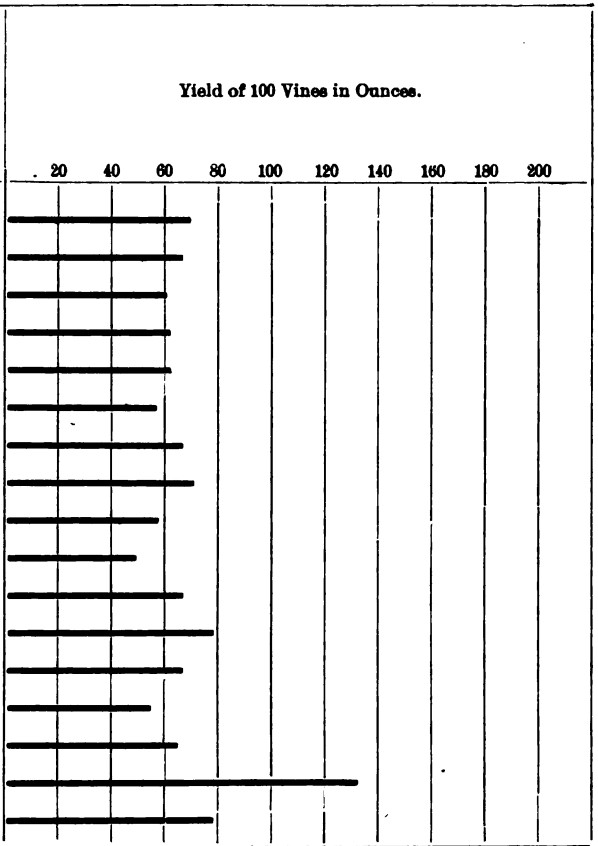

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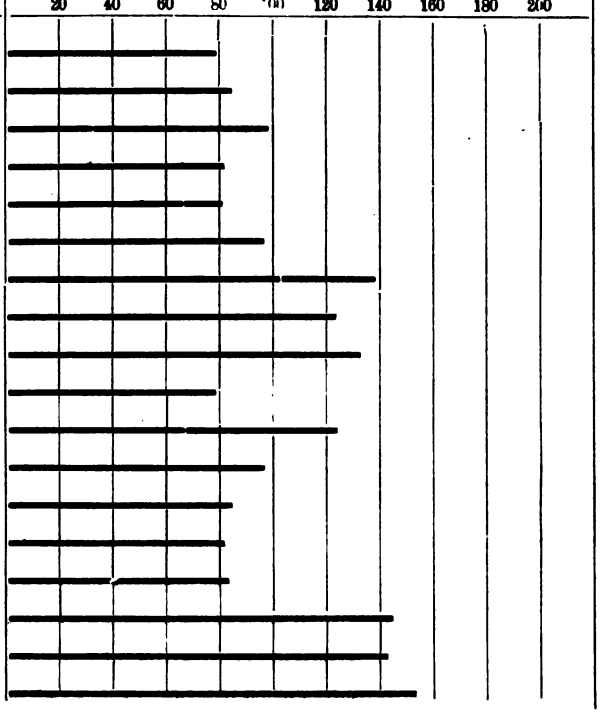
TABLE No. 2.—VARIETY TESTS OF PEAS.—*Continued.*

VARIETIES. Arranged in order of their maturity.	Seedsmen.	Per cent of germination.	Height of vines.	No. days to edible maturity.	No. pods per 100 vines.	Average No. peas per pod.	Per cent of peas to total weight.	Yield in ounces from 100 vines.
Premium Gem	Ferry	50	1½	51	370	6	52	79.2
McLean Little Gem	"	46	2	51	425	5.8	47	83.4
Universal	Childs	66	1¾	50	585	5	48	99.6
Kentish Invicta	Ferry	75	3	51	710	5.25	48	82.4
Wm. Hurst	Burpee	50	1½	52	420	5.5	63.5	81.5
Exonian	Thorburn	48	2½	53	509	5.3	52	97.5
Early May	Salzer	59	1½	55	785	7.7	52	139.7
Petit Pois	Henderson	67	3	56	890	6	51	121
Profusion	Burpee	30	2	56	678	5	48	134.3
Stratagem	Ferry	75	2½	61	445	4.6	52	76.7
Juno	Henderson	45	2½	60	567	5.7	55	123
Stanley	Dreer	53	2¼	60	470	5.1	50	98.5
Shropshire Hero	Manle	62	2½	60	445	5.5	55	85.9
Pride of the Market	Ferry	47	2	60	341	5.5	54	82.1
Gladiator	Henderson	48	2¼	61	378	5.3	49	82.5
Heroine	Dreer	30	2½	60	500	6.2	53	144.9
Heroine	Henderson	52	2½	61	425	6.3	45	142.8
Abundance	"	28	3	61	844	5.2	49	148.8



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Bliss Everbearing	Ferry	47	2¼	61	571	5.2	47	100.7		
Blue Imperial	"	78	2	59	880	4.75	45	97.3		
Yorkshire Hero	"	25	2¼	63	441	4.3	52	106.7		
Melting Sugar	"	91	5	58	510	5.4	45	104.2		
Telephone	"	25	4¼	60	270	5.7	52	66.5		
Forty Fold	Buist	45	4	61	505	4.6	49	101.1		
Admiral	Ferry	80	3	61	745	7	52	137		
Telegraph	"	62	3¼	59	470	6.6	46	125		
Telegraph	Dreer	54	3¼	60	480	6.4	44	128		
L. I. Mammoth	Childs	57	3¼	59	731	5	55	137.4		
Evolution	Henderson	53	3¼	61	530	6.1	48	132.5		
Fillbasket	"	25	2¼	62	646	7	52	187		
Eugenie	Buist	23	2	63	741	6.8	52	178.4		
Market Garden	Henderson	60	2¼	63	590	5.9	65	133.3		
Dwarf Telephone	Hicks	87	1¼	62	909	7	47	145.7		
Champion of England	Ferry	31	5	63	785	7.2	53	196.2		
American Champion	Henderson	36	3¼	62	409	5.5	48	138.4		
Duke of Albany	Ferry	40	3¼	63	899	5.1	51	96.4		
Sanders Marrow	Henderson	23	5	65	768	8.3	34	135		
Sutton Satisfaction	Currie	6	2¼	65	827	5	44	202		
Tall Sugar	Ferry	66	5	73	520	5.7	45	98		

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BUSH BEANS.

H. P. GLADDEN.

Beans do best in a rather light, well drained soil. Although, in ordinary soil, a fair crop may be grown without the use of manure, its application, in a well-rotted form, can be made with profit.

If the garden is laid out in long rows, which is the preferable way, as it permits the use of the horse cultivator, the drills should be from two and one-half to three feet apart, but where the work is done by hand, the rows may be as near as fifteen or eighteen inches. The beans should be sown two or three inches apart in the drills, and, after covering two or three inches deep, the soil should be firmly pressed over the seed.

Beans are easily injured by cold or excessive moisture. It is usually safe to plant the first crop at the time corn is planted. For a succession sow every two or three weeks until the first of August.

Care should be taken to give the plants shallow cultivation, as disturbance of the roots, especially during the blossoming period, will result in a decreased crop.

There are many varieties of beans differing in earliness, productiveness and in the size, color and quality of pod and seed. Of the green-podded varieties, a well selected strain of *Red Valentine* will prove satisfactory. For a family garden preference is given to the wax-podded sorts. *Cylinder Black Wax* is very productive, with long, round and light yellow pods. This variety planted in succession will give snap beans that are tender and of best quality throughout the season. *Mammoth Wax* and *Butter Wax* may also be mentioned in this class. As a shell bean, *Dwarf Horticultural* or *Goddard Bush* are excellent. Among the recent introductions may be mentioned *Speckled Wax*, very promising as a snap bean and later as a shell bean.

POLE BEANS.

This class of beans is very tender and should be planted two or three weeks later than the bush beans. The rows should be from four to five feet apart, with four feet between the hills. The poles, which should be about eight feet long, can best be set in place before the beans are planted, as disturbing the young plants injures their growth. It is well to make the hill quite rich, by working into the soil a shovelfull of well composted manure.

Golden Cluster is an excellent pole snap bean. The plants are strong growing and very productive, and the pods are large, tender and of the best quality. *Golden Champion* is also a good variety.

The *Pole Limas* are late in maturing and are usually killed by frost before much of the crop has been gathered.

A variety worthy of special mention is the *Horticultural Lima*. It is productive and ripens the crop before frost comes. It is unexcelled as a green shell bean and is a good cooking bean when mature.

Warren, Gregory. A recent introduction. Plants of strong, vigorous growth; pods three to four inches long, usually straight; flesh thick, tender and of best quality. The plants are productive and the pods mature successively for a long season. An excellent home variety.

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CELERY.

Celery is seldom grown in the farm garden, as its cultivation is thought too difficult for the amateur. The growing of this excellent vegetable is not so hard as imagined and it should receive more attention than is now given it. The seed should be sown early in the spring. Select a level spot and make it rich with well rotted manure. Thoroughly pulverize the soil and sow the seed in rows about eight inches apart. The seeds are small and an ounce will produce over five thousand plants. When the plants are three or four inches high the tops should be clipped to make the plants stocky. To grow good celery it is quite necessary that the soil be heavily manured and one that will not dry out, and, if possible, loose and deep, though good celery may be grown on clayey ground. The rows may be four or five feet apart and the plants six inches distant in the rows. The plants should be set not deeper than they were in the bed and the soil firmly pressed about the roots. When the plants are about ten inches tall the celery wanted for fall use should be banked up to blanch it; this operation should be repeated as the tops grow. The celery intended for winter storing should be earthed sufficiently to induce the stalks to grow upright. Celery will stand several degrees below freezing without serious injury. About the first of November the plants should be placed in trenches or in the cellar to blanch for winter use. If stored outside trenches should be dug eight or ten inches wide and as deep as the celery is tall. The earth should be loose at the bottom of the trench. The plants, with the roots on, are taken from the rows and packed closely in the trench with the tops even with the surface. As cold weather comes on the tops should be covered gradually, with some loose material, until they are protected from serious freezing. Celery may be placed in the cellar by having boards eight or ten inches apart to prevent packing in a compact mass. Soil should be packed about the roots that they may start to grow, as this growth in the trench or cellar blanches the stalks. Earth is not necessary between the stalks.

The dwarf varieties seem to give better satisfaction than the larger growing kinds. *Golden Self Blanching* and *White Plume* are good varieties. If a pink sort is desired, *Rose* will give good satisfaction.

CUCUMBERS.

Cucumbers prefer a light sandy loam well enriched. The rows may be five to six feet apart, and the hills three or four feet distant in the rows. In this locality June 1st to 10th is the time to plant. The striped beetle is very troublesome to the young plants. A good way to protect the plants is to grow them for a time under a cover of netting or wire screen fastened on a frame. When the plants are well started they will keep ahead of the insects. Seed should be planted every two or three weeks to provide a succession through the season. Plants will continue to produce fruits much longer if no cucumbers are allowed to ripen on the vines.

One of the best varieties to grow for general use is *White Spine.* There are several strains of this variety differing somewhat in growth, productiveness and in time of maturing. *Fordhook Improved White Spine,* Burpee, is one of the best of its class. The plants were very strong growing and productive and the cucumbers large and perfect in form. As a sort for

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growing pickles and for early table use *Russian* is good. The fruits are small but are produced in large numbers. As a later variety *Long Green* may be mentioned. The cucumbers are large and among the best for table use.

LETTUCE.

A common mistake made in growing lettuce is in having the plants too close together. To reach perfection the plants should be ten to fifteen inches apart in the rows.

Lettuce is quite hardy and the seeds can be sown quite early. To provide a succession sow every two or three weeks.

As varieties for general growing *Black Seeded Simpson, Hanson, Grand Rapids* and *Prize Head* are among the best.

The following are sorts of recent introduction:

Onondaga, Burpee. It forms a large compact head. The outer leaves are curled, yellowish green with brownish red edges. The inner leaves are rich yellowish green in color and of excellent quality. It stands heat well and is a promising variety.

Iceberg, Burpee. *Ice*, Pitcher and Manda. The heads are of medium size; leaves somewhat curled and wrinkled, edges brownish red. Every plant formed a good head during very dry weather. Its handsome appearance, high quality and ability to withstand drouth make it well worthy of general planting.

SALSIFY.

This vegetable is of such easy culture and so little known that a few words in its favor may not be out of place. Sow the seed early in spring in drills. If hand cultivation is practiced the drills may be twelve or fifteen inches apart. The plants should be thinned out if they are growing too close. Late in the fall the roots may be stored in the cellar or a trench outside for use during the winter and spring. They may be left in the ground until spring without injury to the roots. The roots make a most excellent dish and the vegetable would be largely grown were its good qualities more generally known.

SQUASHES.

Of late the squash vine borer has made the growing of this vegetable somewhat uncertain, though a large proportion of the damage supposed to be done by the borer is due to a fungus which attacks the vine. Corn cobs soaked in coal tar and placed about the hills when the plants are small repels the moth that lays the eggs which produce the borer. The tar should be renewed every four or five days. The striped beetle may be kept away by covering the plants as recommended with cucumbers. A tablespoonful of turpentine mixed with a pailful of ashes and sprinkled on the plants early in the morning has been quite successfully used to keep away the beetles.

Summer Crookneck and *White Bush Scallop* are usually planted for early squashes. *Long Island White Bush*, a recent introduction, seems to be an improvement upon the usual type. The plants are very productive and the squashes larger, smoother and more regular in form than the com-

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mon *Bush Scallop*. *Boston Marrow* is a good fall and early winter squash. *Hubbard* and *Marblehead* are among the best for winter use. *Essex Hybrid* is a productive sort and the squashes are of good quality; by some they are preferred to the *Hubbard* for fall and early winter use. *Cocoanut* and *Fordhook* are strong growing varieties which are almost sure to bear a large crop. The squashes are small, but of good quality.

Delicata, recently introduced by Henderson, belongs to the above class. The plants are strong growing and healthy. The squash is about six inches long and three to four inches in diameter. It is of a rich, creamy yellow color and the flesh is dry and of excellent quality. Matures the last of September. Somewhat similar to *Fordhook*, but is less ridged and more oval in form.

TOMATOES.

The seed was sown in the forcing house April 1. The plants were set out June 6 and 7. The rows were six feet apart and the plants set four feet apart in the rows. The trellis described in bulletin No. 57 was used to support the vines. Ninety varieties or strains were grown. The table given below shows the time of ripening and the yield of a few of the older and better sorts, and of the new varieties grown. Six plants were set of each variety. All the ripe tomatoes borne on these six plants were picked and weighed. After the frost had killed the vines the green tomatoes were also gathered and weighed.

The variety which has given best satisfaction, as an early tomato, for several season is *Earliest*, from Vaughan. The six plants supposed to be *Earliest* in the experimental plot were not true, so that a comparison for this year could not be made. Our field planted for general use contained a large setting of *Earliest*, and here it was the first, by several days, to ripen fruits.

Advance, which is a little later than *Earliest*, but bears a smoother fruit, shows up well as an early sort.

Ignotum, *Lorillard* and *Optimus* may be recommended as among the best for the general crop.

The following notes on some of the new varieties may be of interest:

Royal Red.—Dreer. Careful comparison could note no differences in plants or fruit from *Ignotum*, though *Royal Red* ripened fruits a week earlier and the tomatoes averaged much smaller in size.

Buckeye State.—Livingston. Plants are strong growing; fruit grows in clusters, is round and of good size, color a uniform pinkish red; flesh solid and walls thick. Free from rot and does not crack. Promising.

Belmont.—Gregory. Plants are strong growing and spread but little. Fruit round or somewhat oblong, many celled and cell walls very thick, few seeds in cells; color bright, light red, does not ripen well around stem.

Terra Cotta.—Thorburn. This is one of the *Rural New Yorker's* cross-bred tomatoes. The type is not fixed and the fruit varies greatly on the different plants. The typical fruit is of medium size, nearly round, with slight ridges or irregularities. It has very thin skin and the cells are close to the outside and have thin outer walls. The center of the tomato is solid and the flesh is bright red in color, juicy and fine flavored. A novelty in tomatoes and possessing many points of excellence.

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TABLE 4.—TOMATOES, TESTS OF VARIETIES.

Variety.	Seedsman.	Date first ripe fruits.	Yield of ripe fruits in August.		Yield from Sept. 1 to Sept. 12.		Yield from Sept. 12 to Sept. 25.		Total number of ripe fruits.	Total weight of ripe fruits.		Average weight of ripe fruits.	Weight of green fruit left on vines.
			lbs.	oz.	lbs.	oz.	lbs.	oz.		lbs.	oz.	oz.	lbs.
Advance	Burpee	Aug. 14	26	5	20	6	25	5	561	72	0	2.00	22½
Acme	Gregory	" 30	8	14	12	8	21	5	200	42	11	3.41	12
Ignotum	College	Sept. 2	0	15	15	9	53	13	158	70	5	7.12	34½
Potato-leaf	"	" 2	1	2	30	9	30	9	141	62	4	7.06	81
Mitchell	Maule	Aug. 29			30	4	21	10	174	51	14	4.78	77½
Optimus	Berthoud	" 30			33	2	33	15	201	67	1	5.33	66
Lorillard	"	Sept. 6			37	2	46	9	258	83	11	5.19	82½
Ignotum	"	" 4			41	1	35	10	162	76	11	7.58	90
Potomac	Harris	Aug. 29	6	12	27	2	16	14	91	50	12	8.92	66
McCollum Hybrid	"	Sept. 2	0	13	11	10	11	7	80	28	14	4.77	51
Potato-leaf Ignotum	College	Aug. 16	15	1	32	9	11	1	138	58	11	6.08	51
Picture Rock	Childs	" 16	16	5	21	15	18	9	224	56	13	4.05	60
Climbing	"	" 15	6	3	21	6	12	12	140	40	5	4.60	25
Majestic	Buist	" 19	16	0	10	13	13	1	190	39	14	3.32	21
Prize Belle	"	" 22	7	11	13	11	22	9	168	46	2	4.39	36½
Royal Red	Dreer	" 26	8	14	9	6	15	15	156	34	3	3.50	28⅛
Buckeye State	Livingston	" 30	0	13	13	3	22	13	84	36	13	7.01	52¼
Belmont	Gregory	" 22	6	7	21	0	15	12	168	43	3	4.11	42
Terra Cotta	Thorburn	" 30	5	8	29	14	31	10	206	67	0	5.20	54⅛
Lemon Blush	"	" 26	5	7	36	6	23	11	171	65	8	6.12	50½
Early Michigan	Ferry	" 30	4	14	40	14	29	3	196	74	15	6.11	97
Nichol No. 5	Nichol	" 31	6	5	16	5	48	11	161	71	5	7.09	71
The Stone	Dreer	Sept. 4			4	7	16	0	37	20	7	8.84	106½
Trophy	Vaughan	" 2	2	15	22	1	18	5	74	43	5	9.36	81½
Richmond	Landreth	Aug. 12	18	11	8	9	15	1	180	42	5	3.76	30
Comrade	Gregory	" 16	17	0	13	15	8	4	274	39	3	2.25	20
The Shah	Henderson	" 22	8	4	10	12	9	12	96	28	12	4.79	25
Giant Tree	Salzer	" 22	9	0	40	7	4	14	147	54	5	5.91	55
First Ripe	"	" 18	7	6	18	12	11	10	130	37	12	4.41	35
Trucker Favorite	Burpee	" 22	6	12	40	7	14	13	184	62	0	5.39	50
Matchless	"	" 22	7	11	40	13	19	12	186	68	4	5.87	53
Red Ponderosa	College	Sept. 2	0	11	30	9	30	13	103	62	1	9.64	56
The Ever Fruitful	Pitcher & Manda	" 2	1	15	23	1	36	7	132	61	7	7.44	64

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Lemon Blush.—Thorburn. Another of the *Rural New Yorker* tomatoes. Plants of very strong, upright growth. Fruit of medium size, round, regular form. It has very thick outer walls, few cells with many seeds and the flesh is juicy and more acid than is usual for yellow tomatoes. Color a rich light yellow. A promising yellow sort and a distinct type.

Early Michigan.—Ferry. An improved type of the old *Red Apple.* Plants very vigorous, the branches growing in a close mass. It was not very early but the plants are very productive and the fruit is of good size, regular form, bright red color and free from rot or cracking. One of the best.

Nichols No. 5.—Nichols. A tomato of the potato-leaf type, but the plant grows stronger and more upright. Fruit a lighter pink and of more solid flesh. The plants are productive and the tomato an excellent shipper.

Richmond.—Landreth. Plants are not of strong growth. Fruit small to medium in size, rough and angular in shape and many celled. One of the first to mature fruits. Valuable for its earliness.

Comrade.—Gregory. In plant and fruit closely resembles *Advance*, though fruit is a brighter red and has more green around stem. Also some fruits are much larger than *Advance.*

First Ripe.—Salzer. Plants strong and of low spreading growth. Fruit round, of medium size, smooth, bright red color; flesh solid, juicy and quite acid in flavor. Matures early and plants fairly productive.

Trucker Favorite.—Burpee. Plants strong growing and productive. Closely resembles *Acme* in plant and fruit. A valuable market sort.

Red Ponderosa.—College. Very similar to *Ponderosa* in plant and form of fruit but the color is red. Plants are productive and ripened a good amount of fruit before frost came.

Ever Fruitful.—Pitcher & Manda. Plants are strong growing and set a large amount of fruit. Fruit large, regular form and light red color; flesh not very firm but of good quality. No rot appeared and fruit does not crack around stem. Resembles *Ignotum* but the tomato is more spherical in form.

World's Fair.—Reed. This proved to be the old *Red Pear*, an early ripening sort of but little value.

AGRICULTURAL COLLEGE,
February 10, 1894.

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THE EXTERNAL CONFORMATION OF THE HORSE.

BY E. A. A. GRANGE, V. S.

Bulletin No. 110.—Veterinary Department.

Some time ago the Veterinary Department issued an advance bulletin having reference to the external conformation of the horse, in which some scales of points were presented, and those interested were asked to make such changes as to them seemed proper and best. The hearty response which met the request has been most encouraging, while the replies furnish much valuable information, of which advantage will be taken when we come to that feature of this issue that bears upon scales of points.

Numerous communications have also been received commending the work of research upon the different styles of conformation met with in commercial horses of the present day, and many correspondents express a keen desire to be informed on all points in connection with the subject of this bulletin.

Before describing the points of the animal it may be well, first of all, to define the expression we so often hear, "*a good horse!*" and will do so by saying that associations have led us to regard *a good horse* as one which excels in many ways, fails in few, and is not remarkably deficient in any point. Of course that is treating the question somewhat broadly, for some horses are able to trot at a very high rate of speed, and are regarded as good horses by those who look upon speed as the chief feature in their ideal animal; yet these same animals may be affected with forms of unsoundness that would cause them to be rejected in any show ring, and the same may be said of horses used for the performance of any special duty.

I do not think it makes any particular difference where we begin with the description of a horse, for if we do the work thoroughly we eventually cover the whole animal; but as it has always been our custom, in work of this kind, to start with the conformation of the head, we will continue in that line here; indeed, in some respects, the head may be regarded as the frontispiece of the animal, it being the feature above all others which imparts the physiognomy or expression to the creature.

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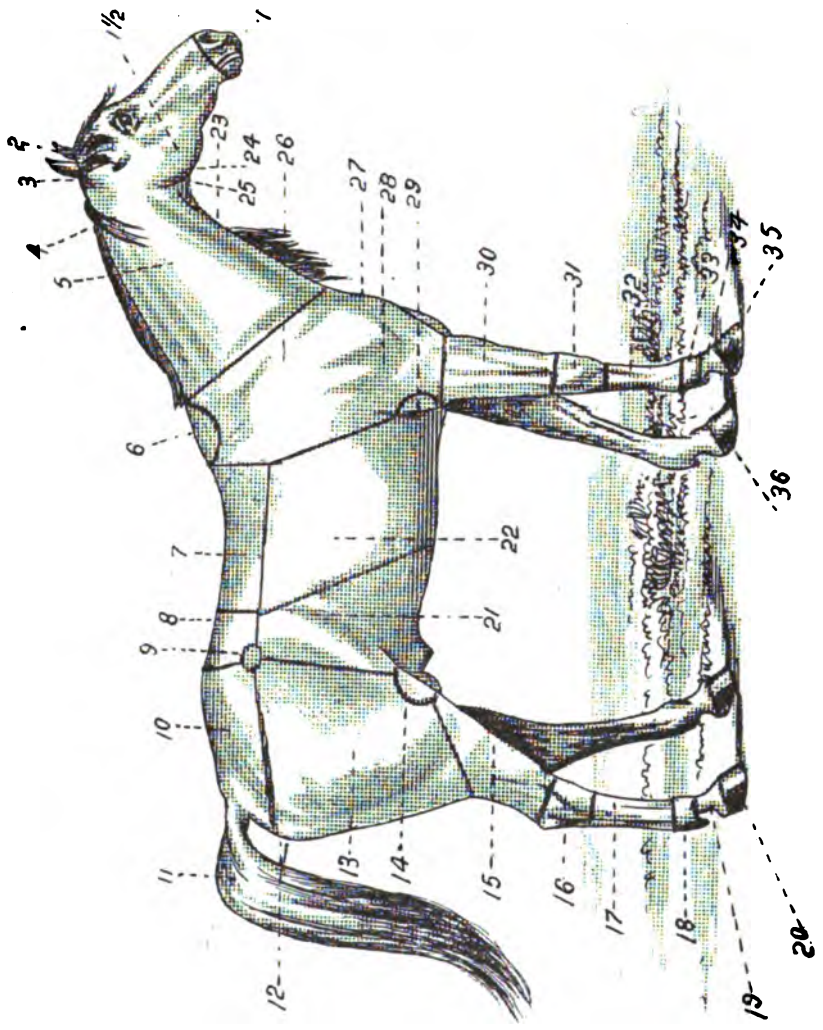

PLATE NO. 1.—REGIONS OF THE HORSE.

1 Muzzle.
1½ Cheek.
2 Crest of occiput.
3 Poll.
4 Crest of the neck.
5 Neck.
6 Withers.
7 Back.
8 Loins.
9 Point of hip.
10 Croup.
11 Dock and tail.
12 Point of quarter.
13 Haunch or upper thigh.
14 Stifle.
15 Gaskin or lower thigh.
16 Hock.
17 Shank.
18 Fetlock joint.
19 Hind pastern.
20 Hind foot.
21 Abdomen and flank.
22 Chest.
23 Jugular gutter.
24 Jowel.
25 Throat.
26 Shoulder.
27 Point of shoulder.
28 Arm (from point of shoulder to elbow).
29 Elbow.
30 Forearm.
31 Knee.
32 Front canon.
33 " fetlock.
34 " pastern.
35 " foot.
36 " coronet.

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THE HEAD

may be divided for the convenience of description into the following regions, viz.: The ear, poll, forehead, face, nostrils, muzzle, mouth, cheek, eye, lower jaw and jowl, inter-maxillary space.

THE EARS (Plate II, Fig. 1–1) are situated towards the sides of the top of the head, and, like many other parts of the horse, are subject to differences of opinion in the minds of individual horsemen as to their proper size and shape, as well as their position upon the head. Some like what they call good large ears set well apart, while others prefer much smaller ones and made up in a more delicate manner throughout. As far as our own observation has gone, the ear which has most admirers is the one which is composed of a mere shell of gristle enveloped in a layer of thin skin, which should be clothed with a coat of fine hair, that may, however, be somewhat meagre on the inner surface, especially in the summer season.

In shape the ear should taper from the base to a rather sharp point at the tip; its movements should be energetic, but not of the quick, jerky order; they should not be slow or sluggish, because that would indicate a defect in hearing or the animal is quite likely to be a dull, stupid brute, while those with quick, jerky ears are liable to be vicious or ultra nervous creatures.

Experience in selecting horses has led us to observe the movements of the ear with much care, and regard them to some extent as the index to the animal's character, for they not only indicate a well-balanced disposition, a vicious or sluggish horse, as the case may be, but they point to defective eyesight, or even total blindness, in which case the ever restless ear will be thrown first in one direction and then in another.

The position of the ears upon the head plays an important part in the artistic appearance of it; if they are too near the center they cause a disagreeable, puny expression, while if they are too close to the lateral borders they give the head a somewhat coarse expression. When erect the ears should stand boldly up, inclining in an oblique direction from below upwards and forwards; when they project in an outward direction, approaching the horizontal, they are called lop-ears, a style of conformation that is not admired.

THE POLL (Plate I–3) is situated at the top of the head (being covered in part by the arch formed by the headstall of the bridle or halter), its shape is not often criticised, though we occasionally meet with saddle horses that are injured from the artistic standpoint owing to the poll being flat and expanded, giving the upper superficies of the neck and back of the head a plain, coarse look, and as this feature is practically always under the eye of the equestrian, it is very liable to diminish the value of the animal in the high-class saddle horse market.

THE FOREHEAD (Plate II, Fig. 1–2) is that part of the head between the eyes, extending as high as the top of the cranium, the superior border affording a point of attachment for the forelock; the upper portion forms a large part of the wall of that cavity which contains the brain, while the lower portion forms the forehead proper, a space that is most admired when it is broad and flat.

Connoisseurs in horse flesh prefer plenty of space between the eyes, and some even go so far as to say that a broad forehead is indicative of intelligence, but as this part of the bone does not cover the brain (the seat of

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intelligence) it is hard to conceive how its shape can control such an important feature in an animal. When the space between the eyes is well developed that portion of the interior of the head to which the nerve of special sense of smell is distributed would naturally be larger in proportion, on that account the smelling power of the animal with the broad forehead may be increased, and if it be true that the horse is capable of judging of the quality of things by their odour, we can then explain why the horse with the broad forehead and well developed organs of special sense of smell, may appear more intelligent than his less fortunate neighbour with the narrow one.

In some instances the forehead is convex in outline, a style of conformation which is not regarded with favor from an artistic point of view, though it is not likely to interfere with the animal from the practical standpoint.

THE FACE (Plate II, Fig. 1, 3–3) is the region situated below the forehead, the bones of the nose forming the principal part of it. The outline of the anterior aspect of the face should be straight or nearly so, causing the nose to be rather of the Grecian order, the sides of the face may be very slightly dished. The bones of the nose are often arched, a style of conformation that is not only unpopular, but in the extreme it may interfere with respiration during severe exertion, owing to the peculiar attitude the soft tissues, which form the nostrils, assume when hanging loosely from such bones, and their position makes it difficult if not impossible for the muscles which control them to act in a proper manner. Again the bones of the nose are sometimes concave, giving the animal a dish faced appearance, which in extreme cases may also interfere with respiration, by decreasing certain diameters of the nasal chambers, but it is only in very rare cases that the merits of the animal are affected by the shape of the nose; notwithstanding this, however, the shape of the nose is a very important point, for it goes a long way in giving a pleasing or disagreeable expression to the head.

THE NOSTRILS (Plate II, Fig. 1, 4½–4½) are the external openings of the nasal chambers; they are composed largely of a fine skin and cartilage or gristle, and lined by a delicate membrane which in health and during repose, should be of a rose pink color; exercise or disease alter the color of this membrane considerably. The openings should be large and easily dilated; if they are small and composed of thick tissues which do not dilate readily, the horse will most likely prove defective when it comes to severe exertion.

THE MUZZLE (Plate I, 1) of the horse is a region somewhat indifinitely spoken of as the end of the nose, but to define its limits I regard it as that part of the head extending from an imaginary line drawn around the lower portion of it and in its course passing over the angle or commissures of the mouth, all below this line to be included in the muzzle. The outline of this region does not seem to make any difference to the animal as far as its merits are concerned, but from the artistic standpoint it must not be coarse and expanded, but fine and inclined to be pointed; to express this, some horsemen say, the animal "should be able to drink out of a wine glass."

THE MOUTH splits the last region into two parts. It should be of moderate size, not deep enough to remind one of the mouth of an alligator, nor so shallow that it resembles the mouth of a sheep; it should be bounded, as it were, by moderately firm lips. We do not believe that its size or shape has anything to do with the general utility of the animal.

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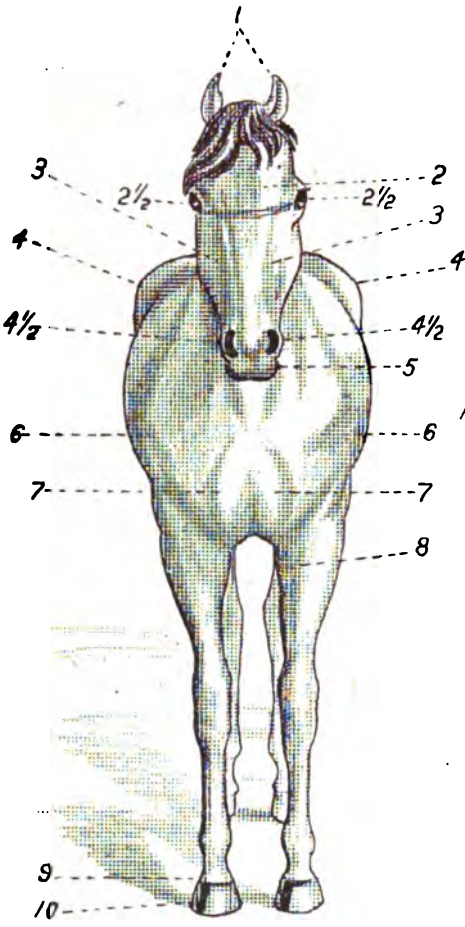

Fig. 1.

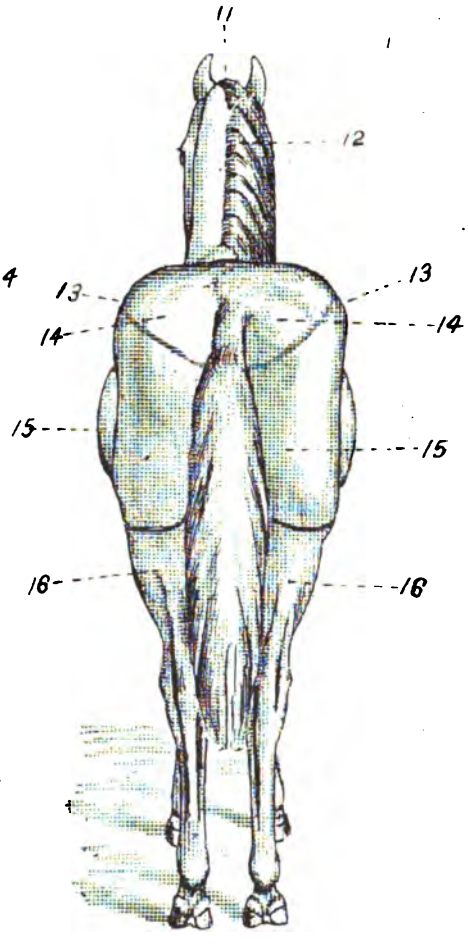

Fig. 2.

PLATE NO. 2.—REGIONS OF THE HORSE.

1	Ears.
2	Forehead.
2½.2½	Outside points of the forehead.
3.3	Face.
4.4	Points of hips from the front.
4½.4½	Nostrils.
5	Muzzle.
6.6	Points of shoulders.
7.7	Muscles forming breast or bosom.
8	Forearm.
9	Coronet.
10	Wall of the foot.
11	Crest of the occiput.
12	Crest of the neck.
13	Points of the hips from behind.
14.14	Croup from behind.
15.15	Haunch or upper thigh.
16.16	Gaskin or lower thigh.

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THE CHEEK forms a large portion of the lateral aspect of the head. As we believe that this region of the head deserves more attention than it usually receives, a word or two concerning its anatomy may not be out of place here. It is composed of an outside covering of skin and hair, and an inside layer of a skin-like mucous substance called *buccal membrane*; between the skin and the membrane we will find two muscles, which are especially worthy of our attention. The first one, called the *Buccinator*, occupies that portion of cheek nearest the mouth, which is loose or flabby. This muscle is of interest because it is largely concerned in keeping the food in its proper place during mastication, by pressing it, as it were, between the molar teeth, which, figuratively speaking, are the mill stones that grind the corn, etc. The next muscle may almost be looked upon as being of more importance than the first, for again, speaking figuratively, it supplies the *power* which drives the mill stones; this muscle is called the *Masseter* (one on each side of the head) and is situated upon the upper or posterior half of the cheek. It is firmly attached to the upper and lower jaw and is the principal muscle of mastication, and as this is one of the important processes of digestion it must be thoroughly performed, or the animal will not remain vigorous and in a state of perfect health. We believe that imperfect mastication, or grinding of the food, is often the starting point of indigestion and all its evil consequences, hence that this act be properly performed, the masseter should be well developed, and we like to see them standing boldly out upon the cheek.

THE EYE is a most important part of the head. It is regarded as being defective from an artistic point of view when it is small and concealed, reminding one of the eye of a pig, or when it is too large, round and prominent, like the eye of an ox. It should be well developed, round and preferably of a brown color.

When there is an absence of the coloring matter of the eye, it will be very light colored, an appearance which usually goes under the name of (watch) *wall eye*.

The eye is frequently regarded as the index of the animal's character, but I have been deceived so often by both kinds, the mild as well as the sulky looking, that I am now disposed to think it is often over-estimated as a guide for future performances.

The acuteness of vision may be determined by making passes with the hand in front of the animal, in proximity to the organ, examining one eye then the other, taking care that too much force is not exerted, as currents of air may be produced which will cause the animal to blink, and this blinking mistaken for actual vision.

THE LOWER JAW is composed principally of a large bone, the front part of which forms a solid foundation for the implantation of the lower incisor teeth. This part is called the body, and springing from it are two large rami or branches; the branches turn suddenly upward towards the base of the ear, near which they form the joint of the lower jaw.

The angle of inflection is often designated the jowl (Plate I, 24). This point if coarsely constructed, through the bone being too broad, is sometimes taken exception to, and the animal criticised for being too thick in the jowl, or is occasionally called heavy-jawed.

THE INTER-MAXILLARY SPACE is the V shaped channel formed by the spread of the branches of the lower jaw. The channel should be deep enough to make its presence quite perceptible. When the groove forming the channel does not exist, owing to the space being filled with thick skin

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or other soft tissue, the head has a beefy look, as it is called, a style of conformation that is rather disagreeable.

The inter-maxillary should be broad between the angles of the jaw in order that the top of windpipe (*the larynx*) may have plenty of room for its eccentricities in all attitudes of the head.

The head should be attached to the neck in a manner that a line drawn through the center of it will form a right angle with a line drawn along the center of the neck, when the animal is standing in its natural position. When the angle is more obtuse than a right angle, causing the nose to protrude, the horse always appears as if suffering from a sore throat; or if the angle is still more obtuse, it will resemble the attitude assumed in chronic poll evil; on the other hand if the angle be considerably more acute than a right angle the act of respiration may be interfered with during extreme exertion. A head that is not nicely set upon the neck deteriorates the value of a high class horse considerably, although it may not interfere with the merits of the animal.

It is somewhat difficult to say, in a general way, how the head of one class of horses should differ from that of another; all for instance are entitled to the fine ears, the broad forehead, the straight nose, etc., etc.; at the same time a coarse ear, which might be tolerated in a draft horse, would more than likely be taken exception to in the thoroughbred; then heads are coarse or fine in all breeds without apparently affecting the merits of the animal, but the same cannot be said of the neck, which is the region of the horse next to be described.

THE NECK (Plate I, 5)

may be regarded as the part extending from the poll to the withers along its upper border, and from the throat to a point a little above the anterior extremity of the breast bone on the lower border. In all breeds of horses we meet with different kinds of necks that are named from their supposed resemblance to certain objects, but the kinds we oftenest meet with are the bull neck, the peacock neck, the ewe neck, the straight neck and the clean cut neck.

In selecting a horse the form of neck must be taken into consideration, and the kind of work the animal is to be engaged in, before we pronounce upon it as being good or bad in form.

THE BULL NECK is the one which is strikingly short and thick; it is usually credited with being indicative of strength and consequently is best adapted for draft horses, but even in them it is doubtful if it is advisable to encourage the breeding of horses with short necks, for innumerable draft horses have been brought under our notice with moderately long necks and we have yet to learn that they were deficient in strength when it came to the starting of a load. The bull necked horse would certainly not do for saddle purposes because he would not be graceful in his movements, and men who ride high class horse, like them with plenty of rein, in order that they may be handled in a more agreeable way; it is not a pleasant thing to have the horse's head too near you when in the saddle.

Those who drive generally prefer the rangy neck to the short variety, for similar reasons.

THE PEACOCK NECK is one which usually has many admirers; the name is given to it from the supposed resemblance to the neck of that bird. The style of conformation is occasioned by the upper border of the neck (*the*

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crest) becoming somewhat elevated or unusually prominent about six inches from the poll; they are found in all kinds of horses and, while they do not indicate anything of special value in the line of merit, they are coveted on account of their beauty.

THE EWE NECK is one in which the upper border is concave instead of being convex and the lower border bulges more or less, giving rise to the expression, "that neck is upside down." Many good horses are formed in this way, though it is a form that is often objected to, more from its appearance than anything else we are aware of.

THE STRAIGHT NECK is one in which the upper and lower borders are practically straight, tapering gradually from the chest to the throat; we find this style both in good and bad horses.

THE CLEAN CUT NECK is the one our preference leans towards; in it the muscles and other parts stand boldly out, the crest is prominent and whip-cordy or wiry, the sides are marked by hard muscles, the lower border, including the wind pipe, stands out perceptibly, leaving a prominent groove, the jugular gutter, between it and the neck above, gracefully incurvated near the throat and attached to the head in a manner that leaves a line of demarkation between the leaving off of the head and the beginning of the neck, doing away with the appearance of a *plastered on* head. The posterior part usually terminates perceptibly just in front of the withers, so that one can tell where the neck leaves off and the withers begin, a point that is not always easy to determine.

Necks of this nature are usually accompanied with a constitution that can stand a good hard day's work either upon the road or at the plow.

THE BODY

is the next division of the horse to be considered, and in order that it may be discussed somewhat in detail it is conveniently divided into the withers, the back, the loins, the croup, the chest and breast, the abdomen; other parts which may be looked upon as part of the body are left to be considered with the limbs.

THE WITHERS (Plate I, 6) is that elevated portion at the top of the shoulder, the highest part of which is the point to be selected when measuring the height of an animal. They are usually described as being *high* or *low*; the latter variety, however, is we believe, more apparent than real, as the length of the bones which form them does not vary as much as one would at first be led to suppose. I have in my possession at this writing a mare, which six months ago was so high? in the withers that a pad had to be arranged under the pommell of the saddle to prevent it from bruising those dainty parts; at this time she is ridden every day with the same saddle (which has not been repadded) and there is abundance of room between the top of the withers and the under surface of the pommell of the saddle; her withers look lower, but there cannot be any doubt but what this appearance is to be accounted for by the increase of fat in the animal's condition. We think a good substitute for the expression high and low withers would be, *well defined* or *obtuse* withers, the former taking the place of the expression "high" the latter of the expression "low;" we do not pretend to say that the comparative lengths of the bones do not vary, but that the variation is not so great or so common as is generally supposed.

Horses with high withers, whether they be well defined or obtuse, are able to perform rapid movements with more grace and facility, other things

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being equal, than those in which the bones are short, making the withers *really* low. This is to be accounted for by the fact that the long arm of a lever (the trapezius muscle) is made longer, and hence its power to swing the shoulder blade backwards and forwards, like the pendulum of a clock, is made greater, but with short bones, not obtuse or rounded withers, this leverage is diminished to a greater or less extent. We are inclined to think that the view we have taken accounts for some horses which look as if they were low in the withers, and are still able to trot and perform other rapid movements with the greatest facility, and that in them the withers are really high but they do not look so, because they are obtuse, and not well defined.

In the selection of an animal, the style of the withers should be well considered. When a saddle horse is to be judged the withers should be well defined in order that the saddle may sit comfortably upon the back. Horses with obtuse round or low withers do not carry the saddle nicely nor its occupant in a comfortable manner, as there is a good chance for the saddle to roll or become otherwise misplaced.

If the coach horse or roadster is under consideration, then those with round withers are not so objectionable, but the low variety, that is those with short bones, are not desirable, unless the action of the animal is such as to warrant them.

In draft horses there is no objection to low withers, though in a general way horses with this part well defined are usually most admired.

It is not an uncommon thing in stallions to find all appearance of the withers obliterated on account of the neck coming down into the middle of the back, as it were. Yet such animals are quite liable to produce offspring with well defined withers.

THE BACK (Fig. I, 7) is that part of the animal extending from the withers to the highest part of the croup, a point formed by the approximation of processes belonging to the haunch or edge bones; the posterior third (approximately) of the back forms the loins, or coupling, as it is sometimes called. Some writers describe the *back* and *loins* as separate parts, but it always appears to the writer that the latter is only a continuation or part of the former, for when we come to consider roach and hollow backs, we find the anterior and posterior part of them so intimately concerned in the peculiar conformation that it is somewhat difficult to tell where one begins and the other leaves off; that is in the living creature, though in the skeleton the line of demarkation is well marked, so much so, that there is good reason for those who prefer to describe them as separate regions to do so.

In selecting a horse the uses the animal is intended for must have due consideration before the back is pronounced upon as being desirable or otherwise; for instance, a horse with a tolerably long back may look well in harness, while the same creature would look entirely out of place under the saddle.

Our experience in saddle horses has led us to prefer those with short backs and strong loins with a gentle dip, not sufficient to come under the head of *hollow back*, but enough to do away with the *straight edge* appearance. The dip we wish to emphasize should be very slight and more apparent as we approach the withers.

Roach-back horses are not desirable for saddle purposes, because in them the gait is usually rough, producing a degree of concussion upon the rider which is unpleasant, to say the least of it.

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The horse with the hollow back is often graceful in its movements, and on that account is agreeable to ride, but the style of conformation is not admired and the deformity is liable to increase with age, and more rapidly if weight is applied to its surface.

When the back of the saddle horse is short and loins broad, it is well adapted to carrying weight, and its various evolutions can be performed with the greatest facility, the broad loins giving plenty of room for the attachment and development of one of the largest muscles in the body, which extends, one on each side of the spine, through the regions of loins, back and withers, and is concerned in nearly all movements of the body. We can scarcely conceive an animal doing a good day's work in the saddle, at the plough, or on the road, if this muscle is not well developed.

For harness purposes the back may be somewhat longer. The moderately long horse has a more or less rangy appearance in harness that is often admired. If an animal is intended for fast, or even moderately fast road work, the back should then be of about the same conformation as that of the saddle horse.

For draft purposes the back which has most admirers is the one which is rather short but broad and straight.

THE CROUP (Plate I, 10 and Plate II, Fig. 2, 14-14) is that part of the upper surface of the body extending from the highest point of the hind quarters to the dock, and embraced between two imaginary lines drawn from the point of the quarter to the point of the hip, one on each side. When the croup is long it shows that the bones forming the foundation of it are long, thus giving plenty of room for the development of those powerful muscles which are often spoken of as the propelling powers of the animal. We give the preference to the horse with the long croup. The slope of the croup is another point which should engage our attention when studying the external conformation of the animal; many persons believe that the drooping quarters are indicative of speed, and while it must be admitted that many fast horses are so formed, yet so many record-breakers are built on the more horizontal plan, that we are forced to believe that the slope of the croup has little to do with the animal's merits, but it certainly has with the beauty of the creature, for when it approaches the horizontal, that is just slopes a little, the tail comes from the body in a manner that admits of its more graceful and elegant carriage, which gives a finish to the contour of the whole animal that is a striking contrast to the indifferently carried tail of the drooping croup, with its low set dock.

In those horses with slanting or very drooping croups the tail usually comes out low down.

THE DOCK (Plate I, 11) or root of the tail is a part which should always be observed when examining a horse, and the animal required to perform in its various paces, then the examiner can readily judge if there is anything radically wrong with its carriage or shape.

Many persons regard the resistance offered by the muscles of the dock when, for instance, the crupper being applied, as an index of the animal's strength and endurance, and it does seem that stiff docked horses are generally good ones, yet we have seen so many limber docked animals which were capable of performing in a most satisfactory manner, that we would hesitate in condemning the horse with the limber dock without some further evidence that it was an inferior animal.

THE THORAX (Plate I, 22) or chest is a region which is of great importance from every standpoint that a horse is judged, and it usually bears a

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somewhat close relation in shape to the kind of work nature has intended the animal to perform. For a familiar example of this we have only to look at the chest of the greyhound to see what a striking contrast it presents with his more surly neighbour, the bulldog, or observe the difference between the shape of the thorax of the English thoroughbred and the Scotch draft horse. In the former we find it deeper from above downwards and comparatively narrow in the bosom; his admirer tells us that he likes 'em deep through the girth! While the connoisseur in the draft class must have them with a good broad breast, with a large full bosom and fore legs well apart. We must not forget, however, that this narrowness of chest and fullness of bosom is modified a good deal by condition, and probably does account to a considerable extent for the well trained and thin race horse being able to gallop with such ease and precision, when the same animal if fat would go awkwardly in comparison. Our observation has led us to believe that the narrow chest, that is comparatively narrow, is more essential to the fast, easy stride of the galloping horse than it is to the trotter; but we do not admire any horse whose front legs, to use a horsey expression, look as if they "came out of the same hole."

The shape of the entire chest, apart from the front legs and muscles connecting them to it, has been aptly compared to a truncated cone with its apex turned forwards and the truncated or cutaway part following the line of the lower extremities of the floating ribs. The ribs form a large portion of the bony frame work of the chest, and to them it largely owes its shape. There are usually 18 pairs of them, which vary considerably in size and shape in all animals, whether they be draft or saddle horses, and it is generally conceded that the merits, as well as some peculiarities of the individual, depend upon the shape and length of them. The first few pairs, those that are underneath the shoulder blade are rather straight, and those behind it are somewhat bent. The ribs increase in curvature from the first pair, which are nearly straight, to the last pair, which are so much curved that they describe a considerable portion of the circumference of a circle; they increase in length from the first to about the ninth pair, and from this pair to the last they get shorter; it is this progressive shortening which gives the truncated appearance to the osseous walls of the chest. The ninth pair of ribs, being longer than the rest and being situated where they are, gives depth to the girth, the point that is so much admired, especially in horses used for any saddle purpose.

Professor Williams, one of our eminent veterinary authorities, says that "shallow chested horses are prone to heaves." In all horses the ribs should be well sprung, or have a well defined angle; that is to say, from about the 7th or 8th pair backwards they should come out from the spine in a manner approaching the horizontal, then dip downwards and soon recurve inwards, towards the central plane of the body. The angle is the part where the rib dips downwards, and when it is well defined it is a good point for several reasons; in the first place it shows that there is plenty of room for the implantation of that large muscle (*longissimus dorsi*) already referred to when speaking of the loins, then the angle does away with the flat sides so often found in washy, delicate creatures. The ribs are considered well arranged when the distance between the last one and the point of the hip is little more than the breadth of a hand, such animals are said to be well ribbed up; but when this space is considerable, the horse is spoken of as being loosely coupled, which is frequently associated with narrow loins, the two together producing a style of conformation that is

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seldom fit for a good hard day's work in any capacity, while the horse that is well ribbed up, other things being equal, is usually able for anything that it may be called upon to do; probably the secret is, that in such horses the chest is well formed and spacious, giving the heart and lungs plenty of room to perform their various functions with ease and comfort.

THE ABDOMEN varies perhaps more than any other part, according to the feed or natural condition of the animal. Some animals are always very full owing to the actual size of the organs contained therein. When the dimensions are very large they spoil an animal's appearance to some extent, and, on the other hand, we occasionally meet with horses that will not fill up, always appearing tucked up in the flank; such animals are often poor feeders and consequently not able to do a hard day's work.

THE SKIN should be supple and loose, having an abundance of little glands whose presence and healthy condition are indicated by the glossy appearance of a well groomed coat.

THE FORE LEG is situated upon the front part of the side of the chest, or rather that part of the leg above the elbow joint, and in a general way it responds to the six anterior pairs of ribs.

That part of the shoulder which extends from the point in an upward and backward direction to within a short space of the top of the withers, is the portion which deserves closest scrutiny when examining the conformation of an animal, for by the incline in the anterior surface of this region we are able to tell, with more or less certainty, what kind of action the animal will have as well as judge it in some other particulars. We cannot call to mind ever having ridden a horse with straight shoulders that was an agreeable animal as far as its gait was concerned. Horses so formed are invariably rough and stilty in the trot, and when it comes to the slow gallop they "go short" and get too far away from the ground in the stride, which is so marked in some individuals that it approaches the bucking gait, and is very different from the elastic graceful movements of the horse with oblique shoulders.

For heavy slow coach work the straight shoulder answers very well, but they are best adapted for draft purposes where the horse is seldom required to go off the walk; in this latter class the entire surface of the front of the shoulder will be flush against the posterior or draft surface of the collar, and when an animal so formed throws his weight into it (the collar), the creature will most likely feel comfortable and every effort to move the load will have, comparatively speaking, greater influence. It is not to be inferred from what has just been said that horses with oblique shoulders cannot pull and pull well; or that horses with straight shoulders cannot perform fairly well upon the road in light vehicles, but other things being equal they are best adapted to the uses assigned to them. Though for saddle purposes the parts must be oblique to modify or dispose of concussion. The space between the point of the shoulder and the elbow joint is sometimes called the arm. We do not know of any special style of conformation that needs description in this region as it is invariably formed in an acceptable manner, but below the elbow joint the leg should be thoroughly examined, and first of all we have the forearm (Plate I, 30) to take into consideration. This should be formed of well developed hard muscles standing boldly out. The circumference of the arm as measured with the tape line is not a good guide to the merits of the creature, for two reasons; in the first place when we come to measure horses by the scores, we will

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find in some of them, that the pectoral muscles, which are concerned largely in binding or attaching the fore leg to the body, are (some of them) attached to the inside of the fore leg, just about opposite the elbow joint, while in some individuals this attachment appears lower down; so much so, that it will be included in the tape line when measuring the part, and as this muscle is not regarded as one of the muscles of the fore arm, it seems unfair to include any of it in the measurement of that part. In the second place the skin of some animals is thicker than that of others, while a species of second skin, that binds down the group of muscles which enter into the formation of the fore arm and called *fascia* by anatomists, is considerably denser in some than in others; again fat is found filling up the parts, so as to make them appear larger, while the muscles themselves may be somewhat poorly developed; but where we find individual muscles standing clearly out by themselves, that is with slight depressions between them, amounting in some instance to grooves, and when they are firm, cordy as it were, to the touch, we may be tolerably certain that such muscles are composed of good tough fibers that can stand the strain and are consequently well developed.

It may not be apparent to all why it is so essential for a good horse to have a well developed arm, but when we come to examine those instantaneous photographs, so common in these times, we will at once see that much depends upon the perfect action of the arm in order that the pace may be continued in anything like a harmonious manner. It will be seen in Plate V, Fig. 2, that at certain stages of progression the entire weight of the body is upon one fore leg, and that the muscles of the fore arm have to carry it over a center as it were, something in the same manner as the athlete progresses with a leaping pole,—the horse must be landed on the other side of the center in a firm, steady manner in order that the next stride may be performed in anything like a proper way, for let anything interfere with the action of these muscles and the next step is so modified that it is far from perfect. We have this often well illustrated in the horse suffering from, we will say for convenience sake, a corn; the animal steps upon something, a small stone for instance, that causes undue pressure at the moment the entire weight of the body is upon the foot, or just as it is about to pass over the center, this undue pressure causes pain which shoots through the whole leg; this causes the muscles of the fore arm to wince and the weight is not carried over the center and landed on the other side in a proper way, and the animal comes down upon its knees or stumbles along in a somewhat awkward manner, if it does not fall down all together.

It is generally conceded that horses with long arms are best adapted for fast work, and it is so often referred to as a point of excellence in the trotter that we were led to measure a large number of horses to determine if possible whether any reliable information could be obtained from the length of the arm and its relation to speed, and our measurements go to show that the length of the arm (from the elbow to the trapezium) is greater in the roadster, proportionately speaking, than in the draft horse. This will be readily seen by referring to the measurements in the table which is to be found further on in this bulletin.

Passing on down the leg we come to the knee (Plate I, 31), this should be nearly straight as far as the outline of its anterior surface is concerned, but the posterior surface is marked by a prominent eminence which does not receive any special name except *the prominence* at the back of the

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knee. This prominence is far more perceptible in some horses than it is in others, so much so that it stands out boldly behind, and below this point the contour of the back of the leg dips suddenly forward, giving the part a cutaway appearance, and good horses are sometimes condemned for being too much cut away under the knee, when the part is really stronger and better formed than the average. It is true that many horses are cut away under the knee to that extent that the leg is weakened, and will not stand the constant "hammer, hammer, hammer on the hard, hard way," but we must distinguish between the horse with an unusually well developed (trapezium) bone which forms the prominence, and the one which is illy formed by being too much cut away under the joint. In the former the condition is more apparent than real, for if we observe the substance of the leg from before backwards just beneath the knee we will find it broad and strong, presenting a striking contrast to the latter, which will be found shallow to that extent that it often becomes a weak link.

The knee should not bend backwards or present a concave appearance upon its anterior aspect, as this produces a condition called *calf kneed*, a style of formation that is much objected to from the artistic standpoint. Neither should the knee bend forward, as such a condition is indicative of its having been exposed to harder work than the tissues forming it could withstand, though we occasionally meet with horses that are over in their knees, and yet able to do a hard day's work without being materially affected, but such joints have a weak appearance and are consequently unpopular.

Between the knee and the fetlock we have a part familiarly known as the canon (Plate I, 32), it is composed principally of the large canon bone in front, with tendons, called the back tendons, behind. In shape it should be flat from side to side, the back tendons should stand boldly out behind, leaving an evident line of demarkation between them and the front part of the region, they should be hard, almost bone like, to the touch, and free from all puffiness. The posterior part of this region may or may not be clothed with long hair, according to the breed or fashion of the times. The skin covering the tissues should lie close to the bone and tendon, producing the sensation when handled that all is skin and bone. Below the fetlock joint and above the hoof we have a region designated the pastern, which is a most important part of the leg, it being the seat of that very troublesome disease, ringbone. Besides examining this part for disease we should regard its shape and direction according to the uses the horse is intended for, and if it is to be used as a saddle horse the kind with long oblique pasterns are more elastic and graceful in their movements than the short upright sort, which are often unpleasant to the equestrian on account of the concussion produced by the more or less upright columns of bone. Our experience has been that we usually find straight shoulders in horses with upright pasterns. In horses used for heavy coach or draft purposes the pasterns may be comparatively shorter, stouter and more upright than those used for saddle or light road work, but very straight pasterns are not desirable, in our opinion, in any class on account of the concussion they are liable to produce, but even the long oblique kind may be, and often are, overdone; in them the strain upon the parts is liable to produce an irritation that in its turn will cause ringbone.

The pasterns of the fore leg are usually a little more upright than those of the hind leg. This being the case we think it one of the reasons why ringbone is more prevalent in the hind than the front pasterns.

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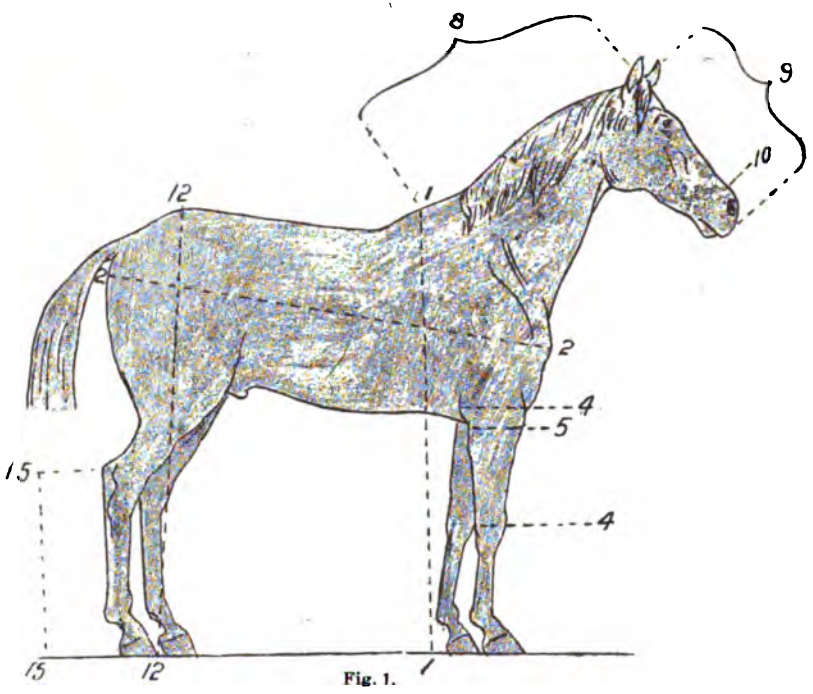

Fig. 1.

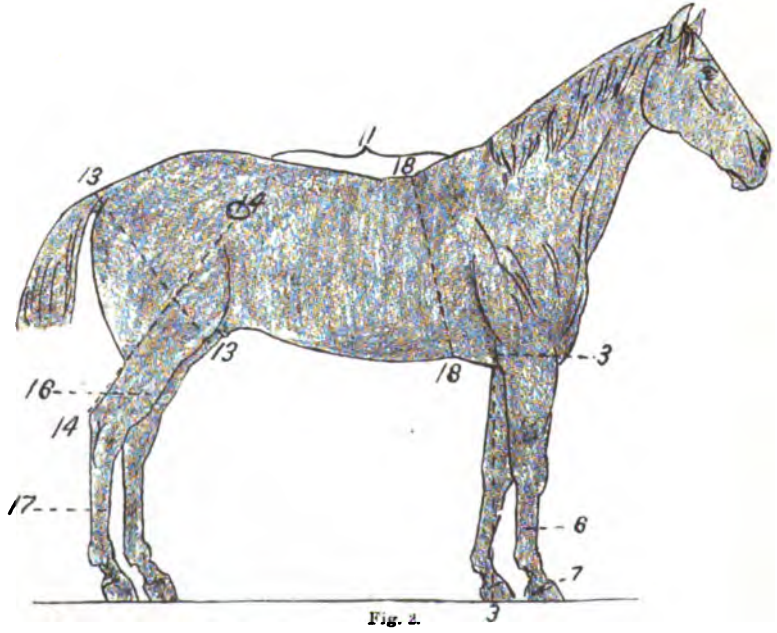

Fig. 2.

PLATE NO. 3.

Points which are measured from and to, are indicated by the numbers on the above figures.

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FIG. 1.

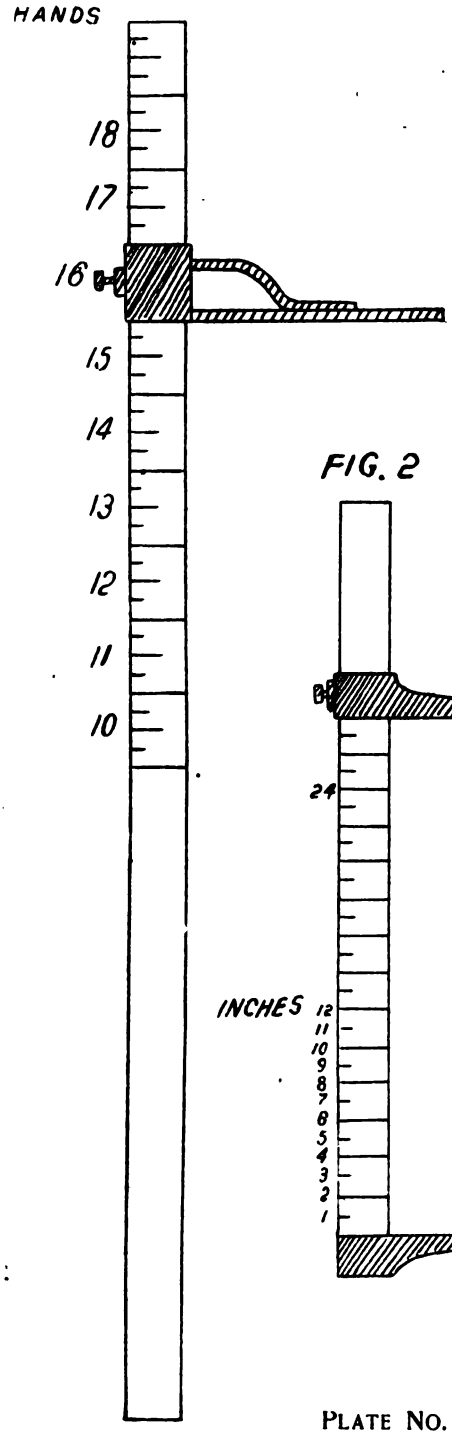
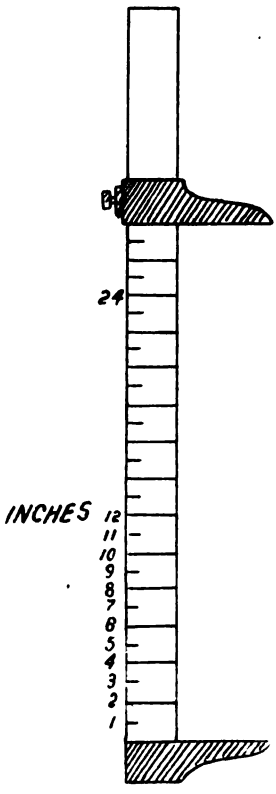


FIG. 2



CONVENIENT FORM OF INSTRUMENTS FOR MEASURING HORSES.

The height of a horse is usually measured in hands, a hand being four inches, 15 hands being just 5 feet, or 60 inches. Fig. 1 is convenient for measuring the height at the withers and croup; Fig. 2 for measuring the width of chest at shoulder points, width of hips, width of forehead and length of head. Other measurements are more conveniently made with an ordinary tape line.

PLATE NO. 4.

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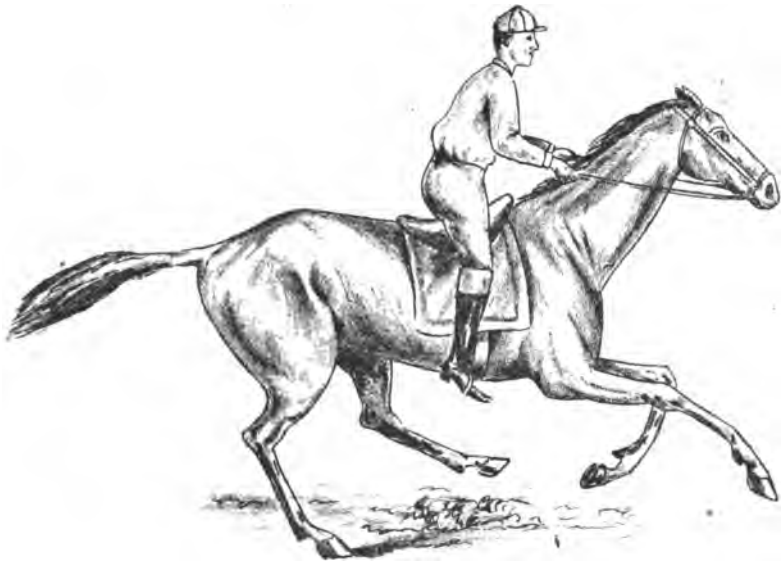

Fig. 1.

PLATE NO. 5.

From an instantaneous photograph. Horse in rapid progression, the entire weight of the body being on one hind foot.

Fig. 2.

From an instantaneous photograph. Horse in the act of rapid progression, the entire weight of the body being on one fore foot.

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Continuing down the leg we eventually come to the foot, a region which has been given a great deal of consideration in all ages and by most writers upon equine topics; indeed it is doubtful if there is any one space in the whole animal which receives so much attention. We hear the expression "no foot no horse" wherever we go, showing in some measure that a good foot is held in high esteem by all admirers of a well formed animal, and a horse with a badly formed one is often dubbed a plug or a screw, in the stable lore of the present age.

The expression is so common that we have endeavored to trace its origin, but have failed to discover the exact source from which it came, so we have concluded that from its being such an old saying it must have originated long before iron shoes were used, and in those days people did a large part of their traveling upon horseback; under such circumstances, with an unshod horse, it does not seem unreasonable to suppose that the horse's hoof would wear out on a long journey, and the creature soon become tender as well as lame and eventually unable to travel; the rider would naturally look for the cause of the animal's inability to progress in the usually way, and on examining the foot and finding it worn out, *gone as it were*, might he not very appropriately exclaim "no foot no horse!" because he would have to abandon that animal, for that journey at all events. When we come to consider what a number of diseases attack the foot, and what a large majority of the cases of lameness which we are daily brought in contact with, have their origin in the foot, we can begin to realize why this part should be regarded as being of so much importance, and the study of *Pedology* or science of the foot, so interesting to those who are engaged in any way in the equine industry.

THE FOOT (Plate I, 35) may be regarded as that part embraced by and including the hoof, the upper border of which is called the coronet (Plate I, 36). We find on comparing the front feet with the hind ones that the former are usually if not always larger and flatter. This is no doubt owing to the fact that they have to bear more weight; in some horses considerably more, for instance the actual weight of a Shire stallion, as I took it, was 1580 lbs.; the front feet were then placed upon the scales and brought the beam up at 940 lbs.; the animal was then reversed and the scales indicated 634 lbs., showing a difference of about 306 lbs. Several other ordinary farm horses were handled in a similar manner with the following results, to wit:

No. 1, a gelding, entire weight, 1180 lbs.; front quarters, 690 lbs.; hind quarters, 510 lbs.; difference in favor of the front quarters, 180 lbs.

No. 2, a mare, entire weight, 1280 lbs.; front quarters, 720 lbs.; hind quarters, 560 lbs.; difference in favor of front quarters, 160 lbs.

No. 3, a gelding, entire weight, 1220 lbs.; front quarters, 660 lbs.; hind quarters, 552 lbs.; difference in favor of front quarters, 108 lbs.

No. 4, a gelding, entire weight, 1150 lbs.; front quarters, 630 lbs.; hind quarters, 510 lbs.; difference in favor of front quarters, 120 lbs.

The slight discrepancy, in those cases of the foregoing between the entire weight and the sum total of the front and hind quarters, is no doubt owing the displacement of the center of gravity in the different attitudes, which could scarcely be controlled. When the animal rests with its foot upon the ground the part we see is called the wall (Plate II, Fig. 1, 10); it is composed of innumerable horn fibres, which run parallel to each other, and are held firmly together by a tenacious substance peculiar to the part. The external surface of the wall should be smooth and free from grooves

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or fissures running in any direction; in outline it should be circular upon its lower border, having a somewhat smaller circumference at the upper or coronal edge. The wall should be moderately deep and strong; if shallow the foot will be flat, a variety which is sometimes a perpetual nuisance on account of often being affected with corns. The wall should not be contracted at the heels, as this form is usually associated with coffin joint lameness or some other chronic disease of the foot. The sole of the foot should be concave rather than flat, and that pyramidal shaped cushion, the frog, which appears as if let into the sole behind, should be well developed. The circumference of the well formed foot is to be found in the table of measurements further on.

The hind feet are invariably smaller and their soles more convex than the front ones; lameness in the hind foot is of comparatively rare occurrence. Many persons believe that feet with dark colored horn are stronger and able to stand the wear and tear of hard work better than the light colored ones, but our experience has failed to demonstrate the truth of this idea. The white foot will show the invasion of the part by inflammation more perceptibly, which we think is the cause of disease often being noticed in the white one when a similar complaint would, and often does, pass unnoticed in the dark colored foot.

THE HIND LEG.

THE HAUNCH OR UPPER THIGH (Plate I, 13, Plate II, 15-15) is a region that is somewhat difficult to define as far as its exact limits are concerned, for we find it running imperceptibly into the croup at one extremity, and into the gaskin or lower thigh at the other, so we will have to draw a little upon our imagination and say that it is situated between two lines, the one drawn from the upper part of the point of the hip to the upper part of the point of the quarter, the other drawn from the stifle joint in an oblique direction downwards and backwards, following the lower border of the prominence formed by that large superficial muscle on the outside of the leg (Plate I, 13). In examining horses as to the excellence of the haunch we should first of all see that the muscles stand boldly out. In the horse where these muscles can be recognized independently of one another, we usually find an animal that possesses a good deal of strength and endurance. Then we should view the animal from behind to see that the hips and quarters are broad. Broad hips are not only indicative of strength but are an immense advantage to the brood mare in the act of foaling, because they indicate a large passage for the foal to pass through, consequently the act of labor can be accomplished with more ease and less risk.

THE GASKIN OR LOWER THIGH (Plate I, 15, Plate II, Fig. 2, 16-16) is the part below the haunch and above the hock; it is important that the anterior and external part of it be well developed, because that part is composed of a group of muscles which are concerned in carrying the body past a center under certain circumstances. If we examine other instantaneous photographs (Plate V, Fig. 1) we will find that in certain attitudes of progression the entire weight of the body is upon one hind foot, and these muscles are largely concerned in throwing it off or carrying it past the center, hence the necessity for a good horse to have a lower thigh composed of tough, hard muscles, and if they stand boldly out all the better, for then the region becomes more attractive.

THE HOCK (Plate I, 16) is a very important joint situated between the

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lower extremity of the gaskin and the upper end of the shank bone. It has been said that a large majority of cases of lameness in the front legs were due to some disease of the foot, but this order of things is generally altered when we come to the hind legs; in them the origin of most cases of lameness, in our experience, has been in the hock joint, and unfortunately the lameness is very often of a most intractable nature as far as yielding to treatment is concerned, unless it is judiciously dealt with in the very earliest stages; hence the necessity of selecting animals with well formed hocks. The variety of hock which gains most favor is the one which is deep from before backwards and broad from side to side; the skin should be in close contact with the hard tissues underneath, doing away with that soft meaty appearance we sometimes meet with. The superficies of the joint should be free from large soft puffy tumours, especially after the colthood days. The hock joint being of so much importance (as it is so liable to become affected with disease), it may be an advantage to the student to make a few suggestions here as to methods of examining it, for which purpose it is very convenient to regard the joint as having four surfaces—front, back, inside and outside. To examine the part thoroughly, both hind feet should be placed together, and in line as we view them from side to side; the examiner should then stand, say three feet out from the point of the shoulder, and make an ocular examination of first one joint, then pass to the other side of the horse and examine the other; in doing this care must be taken to see that both joints are alike, especially at that point where the front and inside surfaces seem to meet. If we find a prominence in one that does not exist in the other we may be tolerably certain that a bone spavin exists in the one with the prominence. In some instances it is difficult to make up the mind by this method, in which case an examination made from between the fore legs looking backwards, and examining first the inner aspect of one nock then the other in quick succession, this will sometimes help us to determine with tolerable certainty; if we are still in doubt, we may get an assistant to hold up one front foot, and manipulate the joint with the fingers, using the eyes at the same time. Should the part be thickly clad with long or furry hair, saturate the surface with water, which will cause the hair to lie close to the skin, and this will sometimes reveal enlargements which would otherwise pass unnoticed. It may be advisable to saturate the hair of both hocks. The saturation of the hair of the parts answers very nicely in examining the pasterns for ringbone or other superficial diseases dependent upon a certain amount of enlargement in any part of the body, if the hair is long. While the assistant is holding the fore foot from the ground, the front of the hock may be examined for that soft puffy tumor known as *bog spavin*, and the sides of the joint for *thoroughpin*; at the same time the outline of the back of the joint may be scrutinized to see if any remarkable deviation from a straight line exists in one hock that is not in the other; if it does, the probability is that a *curb* is the cause of it. It must be remembered that similar diseases do sometimes exist in both hocks at the same time, in which case it may be necessary for us to be familiar with the anatomy of the parts in a manner that can only be obtained by dissection or careful examination of the dissected parts, before we can distinguish between the natural formation and disease—for instance, we have *curby-hocked* horses, a style of conformation that may cause a doubt as to the existence of disease in the mind of those who have not given this subject a good deal of careful attention. This suggests the commendation of the growing

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tendency to have a veterinarian in the show ring to decide cases which properly come within the jurisdiction of such an expert. The question as to why the hock joint is so often the seat of lameness or disease often claims our attention, but if we examine it from the anatomist's standpoint we will at once see that it is a very complicated joint, really made up of a number of little joints, and like other complicated things is quite liable to go wrong; but this is not all, for if we watch a horse in motion, fast or slow, backing or advancing, we will see that a more acute elbow is formed by this joint than at any other part of the leg, and in such a manner that it has to bear the strain of two levers, so much so that we might reasonably wonder why it is not oftener deranged; this perhaps may be explained by the fact that one of the levers at all events works upon the jack-screw plan (which may possibly have something to do with the origin of the term jack spavin), for evidence of this we have only to watch a horse drawing a load over a surface where the footing is a little slippery and we will observe that the hind foot turns around in a somewhat circular manner as if boring into the ground. As far as I am able to conceive from my knowledge of the anatomy of the hind leg this circular motion can only be produced, without increased expense to muscular force, by the peculiar shape of the bones entering into the formation of the true hock joint, the action of which, as pointed out by Prof. Williams, of Edinburgh, is like a screw, and in our opinion there is little doubt but that this screw-like motion is continued down to the foot under certain circumstances. This screw like motion is again important during rapid movements in trotting, especially in the horse with much hock action, as it prevents him from striking the lower surface of the body during extreme flexion of the joint, the foot being wound in an outward direction as it ascends from the ground. The circular motion of the foot is sometimes called *dishing*, possibly because it occasionally gives one the impression that the ground is being scooped out or *dished* by it. Some horses exhibit the dishing movement much more perceptibly than others do, which indicates that the screw like motion in the hock joint of some horses is greater than it is in others; then, if we are to regard the screw form of leverage as being the most perfect because it is the strongest, why other things being equal, the horse that dishes most will be the best performer, it does not matter whether it be under saddle, in the road wagon or at the plow.

Many years ago a gentleman once said to me that in the part of the old country where he came from they often used the expression; "a good disher means a good jumper." Our experience with horses rather verifies the truth of this expression, not only that they are good jumpers but good performers in a general way.

THE SHANK (Plate I, 17) is the part below the hock and above the fetlock; it corresponds to the canon of the front leg; proportionately speaking it is a little longer, flatter and measures more in circumference, as will be seen by comparing the measurements of different horses (see table). In shape it should be flat and deep from before backwards, the skin lying close to the bone and tendon—hard, flat legs being the ones which are best able to stand the trying work of the day. Those round, soft legs we so often meet with frequently prove a source of continual annoyance on account of being affected with Grease or some other similar disease.

The parts below the shank are so much like the same parts in the front leg that they do not require any special description except to repeat that

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the foot is usually smaller and more contracted, with the sole more concave and the frog a little less developed.

COLOR. It has been said from time immemorial that "a good horse cannot be a bad color," but we beg to take exception to this ancient adage, for we believe that a bad color often spoils a good horse from an artistic standpoint at all events, which at once becomes quite a point for consideration when we place an animal in the market for sale, though we do not intend to infer that we believe that the color affects the merits of the animal as far as performance is concerned, but rather that it is just as necessary to have a good color to complete the *tout ensemble* of a stylish carriage horse or a high class park saddle horse as it is to have a well formed head for instance.

It is often said that color has some significance in judging of the temperament of an animal, but our investigations in this line have not led us to believe that there is any reliance whatever to be placed in opinions formed upon such a theory. It is true that many chestnuts are high spirited, but the same may be said of any other color. Temperament is controlled, in our opinion, by something deeper seated than the skin, most likely the chief organ of the nervous system, the brain.

It is also contended that the color has much to do with the individual comfort of the animal when exposed to the influence of the sun's rays, more particularly in the summer season, but our observation has not demonstrated the truth of this supposition; for as far as our knowledge goes dark horses are able to do just as much work without showing fatigue on the farm or the road as lighter colored ones. This may perhaps be accounted for by the non-conducting properties of the coat, for the hair being a non-conductor, it probably makes little difference to the parts beneath what color it is as far as transmitting the influence of the sun's rays is concerned.

The power to resist heat or cold is, we believe, invested in the constitution of the animal.

It was generally conceded by those Greek and Roman equestrians who wrote before the Christian era, that a good horse could not be judged by its color, although one of them goes so far as to say: "That a mane which is of the same color throughout and of fine hair is generally the best, and besides it is most unlike that of the ass and the mule." (See The Art of Horsemanship, by Xenophon, translated by Morgan, page 108.) I cannot help thinking that the writer regarded the *mane* in the same light that we do the *coat* or hair covering the whole body, in which case it is evident that like many persons of today, his taste ran to solid colors, but he does not give any preference to shade. The primitive colors of the hair of the horse appear to be *white*, *red*, *black* and *yellow*, all other shades or mixtures being simply modifications of one or more of them. If we infiltrate a few atoms of yellow into the white hair we get a cream, which is represented in the equine race by quite a variety of shades, according to the proportions of white and yellow.

If on the other hand we treat black and white in the same way, we get a dun color, which also has a variety of shades; while red and yellow, with some white, seem to produce the various shades of chestnut or sorrel, and bay as well as brown are no doubt produced by a delicate mixture of the four primitive colors. In some animals only one color is apparent, while in others it seems to take all four to produce the exact shade. The amount of coloring matter supplied to each individual hair is arranged by nature

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in many different ways so as to produce very different results. For instance, we find rings of certain shades surrounding spaces of other shades, producing a dappled appearance, which is often admired, as the dappled grey, dappled bay or dappled brown, etc., etc., though we do occasionally meet with horses where the dapple does not improve the appearance. In other individuals we find the different colored hairs arranged so as to produce numerous shades of grey caused in a somewhat interesting manner by the predominance of one color or another; black and white producing iron grey; red and white, roan grey, or yellow and white, Isabella grey; the two latter with black hair produce roans of different shades, red roan or yellow roan, as the case may be. These, like all other shades, become light or dark according to circumstances.

We also meet with horses which are of two distinct colors, having sharp lines of demarkation between the one and the other. Indeed we have the different colored hairs arranged in so many different ways, that it does not seem necessary to attempt to describe them all here; while we occasionally have animals brought under our notice where the coat is of that peculiar tint that it becomes a matter of some difficulty to draw a line between one color and some other; browns are sometimes so dark that it is hard to say whether they are black or brown, and similar instances come before us in other shades, the cream and the bay, the chestnut and the cream and so on.

In selecting horses for the market color plays an important *role* in the make up of the animal, so the use the creature is intended for should be given due consideration. If we want an animal for park saddle work solid colors take well, while in most instances badly marked pie-balds would not be looked at, although for the circus ring they might be most coveted; again the dictates of fashion influence the demand and in some localities red roans will bring a higher price, all things being equal, than any other color. For farm work the darker colors generally look better and are less disagreeable in the warmer months of summer than white or other light colors. Extensive correspondence on the subject of color has demonstrated very clearly that much stronger prejudices exist amongst the patrons of the equine industry than is generally supposed, but happily the color does not, in our opinion, make any difference except for special purposes, this being the case we are all put at liberty to gratify our own tastes in selecting a particular hue.

ACTION AND GAIT embrace those movements performed by the extremities during progression, and may be considered under three primary heads —the walk, trot, and gallop—with their various modifications, the running walk, the amble or pace, and the canter. These we regard as natural gaits since horses possess them through some natural predisposition or instinct. The artifical gaits or ornamental movements are those which are taught in the high school of horsemanship, and perhaps may be regarded as belonging more to the circus ring or tan bark of the riding school, than the ordinary commercial horse-world. They consist principally of the *passage*, a species of trot in which the animal gathers itself into a rather showy attitude and progresses in a somewhat elastic manner, the *Spanish* walk, a most majestic movement in which the animal progresses in a remarkably precise manner especially as far as its front legs are concerned; the *Spanish* trot bears a very strong resemblance to the walk, the majestic precise movements being very perceptible. There are many other high school movements which it is not necessary to mention here.

Although we have divided the gaits into two groups, it must be remem-

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bered that a natural gait in one horse may be entirely artifical in another; indeed we can hardly take up a live stock paper without reading of some converted trotter or pacer, as the case may be, while I have seen horses that did the Spanish walk or trot without an hour's training. Some horses cannot walk in the ordinary sense of the term, nor can others gallop, but so many are born possessing the first named gaits, that we feel justified in calling them natural, while the high school movements are obtained through training in nearly all instances.

In pursuing our investigations with regard to the gaits of the horse our chief aim has been to notice those movements which attract the attention of the rider or driver, and the more we inquire into this branch of our subject the more we are struck with the absolute necessity of selecting animals with the *correct way of going* if we desire to obtain the paying prices for our products when we offer them for sale. A gentleman from New York who has had a great deal of experience in the horse line in various capacities not only as an owner, but as a judge at the national horse show and other prominent exhibitions in the east, writes in reply to my inquiries that: "*A paragon of conformation and all the requisite virtues will bring $175–$300 here without action; one not half his equal in any particular, but with extra action will bring $700–$5,000. I have seen very poor individuals bring the latter price more than once.*" At the horse show of the Columbian Exposition I was much interested to observe the amount of stress exhibitors laid upon *action* in the draft classes as well as other breeds.

In pronouncing upon the action of a horse as being good or bad due consideration must again be given to the use the animal is intended for, because what might be looked upon as good action for one class of work, would appear rather indifferent for some other; take the saddle horse, and it is hard for the writer to conceive a more agreeable way of covering the ground than upon the back of a horse that has a nice long easy swing in the trot, going rather close to the ground, but with sufficient knee action to carry the toe well clear of all irregularities in the road bed; this with energy and moderate speed, goes a long way towards the make up of a good saddle horse; but the same style in a coach horse would hardly pass muster if intended for fashionable city driving; in addition to this (for saddle work) we must have the horse to canter nicely, with a long easy stride, free from that short bucking motion so often noticed in badly trained or inferior animals; the walk should be energetic, fast and smooth with plenty of elasticity to modify concussion. In some localities and with some persons the running walk is indispensable in the makeup of a first class saddle horse. The harness horse should be a good walker, a free, bold trotter with plenty of knee as well as hock action; the former must not only be high, but it must be far reaching so as to carry the foot through a telling space at every stride and do away with that short choppy action sometimes described by an old saying "that such and such a nag will trot all day in a bushel basket," while the latter must bend the joint thoroughly, bringing the foot and curved pastern up from the ground in a sharp decisive manner, carrying them well forward and lowering them with energy and precision that reminds one of the movements of a clock, all jerky movements that indicate string halt being carefully avoided.

For slow draft work upon the farm, road, or in the city, the walking gait is even of more importance than any other, so much so that some agricultural societies award prizes for the best walker, an innovation to be highly commended.

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Having disposed of the external conformation of the horse in a somewhat summary manner, let us turn for a moment to scales of points used in judging horses. In order to demonstrate the position we have taken with regard to them we reproduce our advance bulletin upon the subject, but wish to say in addition, that from information gained from numerous contributors we think the most satisfactory way to arrive at a scale of points which could eventually be looked upon in the light of authority would be through a national or international congress, made up of delegates from the different breeds and classes of horses, and let their decision as to what is required govern all *association show rings.*

The replies to the advance bulletin are to be counted by the hundreds, and, after reading them all carefully, the conclusion reached was that if it were possible to put them into a bag and shake them up thoroughly, the scales of points as we have arranged them would come out with so little change that one would hardly recognize it, although many writers took exception to the intrinsic value of all points on the body of a sound horse being equal (in this case a value of 5), some saying that the hock is of more importance than the head and consequently should have more points; but (leaving unsoundness out of the question), does not the head as often spoil a good horse as the hocks? Another says it is hardly fair to allow as much for the croup and dock as it is for the chest, but are there not as many horses injured from illy formed croups and crooked docks as from badly formed chests? And similar questions may be asked throughout the entire list.

It has also been suggested that one score card be arranged that will include all breeds and classes, the strong points of the different kinds of animals being emphasised in such a manner that they are not liable to be overlooked.

These and other questions are the ones which we think can only be settled by a congress of representative horsemen. We do not presume to offer anything more than the suggestion here.

Some horsemen are strongly opposed to judging horses by scales of points, and while there may be many good reasons why men of extensive experience in such matters should be permitted to form their own opinions after the fashion of time-honored custom, yet there are cases where, even to the most experienced, a standard of excellence would prove itself a very great convenience. The writer can call to mind a case of judging horses at an agricultural fair in a rural district, and in the draft class the horses were finally brought in line for inspection, but much to our dismay there was not what we would regard a draft horse in the lot, they were all under size and too light, but the first prize was, with much reluctance, eventually awarded to a handsome little pair of stout cobs, just such a pair as would look well before an ordinary express wagon, where moderately fast work was required, but entirely out of place in the draft truck, where the speed is seldom beyond the walking gate; certainly they might have been thrown out altogether, but there was no authority for such a procedure, nor did previous custom in that locality warrant it. On another occasion a line of saddle horses was presented; amongst them was a grand colt, with proper action and all the necessary requisites for a saddle horse, in fact as far as conformation and style went he was the only true type of a saddle horse in the lot, but he had one wall eye, a rat tail, and was of a most objectionable color, being pie bald on the hind quarters, mostly bay on the barrel and sides of the chest, and an indefinite roan on the neck and shoulders.

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He did not get the first prize! although there were those there who thought he should have had it, and perhaps not without good reasons, but the variegated coat, the wall eye and the rat tail were so far from our ideas of a good saddle horse in the ordinary acceptation of the term that the prize went to another animal far inferior in point of merit. The propriety of these and similar decisions must remain open questions until the more salient features or essential factors in the makeup of a certain class of horse is defined by a recognized standard or scale of points. When this is produced the student can then form an intelligent opinion, within certain limits, as to what may be accepted or rejected in any named class, while those of more extended experience will have authority for supporting their opinions in cases were lines have to be drawn between one class and another, and breeders will be encouraged to breed more to type than they are at the present time.

We think that in judging horses by scales of points each and every point should be valued according to its merits as compared with the same point in other animals which are in the ring and before the committee for award, and not by its supposed importance or relative value as compared with other points in the same animal in a standard which allows say 100 or 1,000 as the maximum of the aggregate of all the points. By the former method the judgment at once evolves into the question of *good*, *better*, *best*, at each point, easier, however, to express by figures, and it insures thorough inspection of all the parts before they can be pronounced upon intelligently, a procedure in itself to be highly commended.

ADVANCE BULLETIN.

For some time past the Veterinary department has been making varied researches upon the different styles of conformation of the horse, with the hope of offering some practical suggestions to those who are engaged in, or about to engage in the equine industry, either as breeders, dealers or occasional owners, as well as to those who are from time to time placed in the responsible position of judges of horses at fairs and horse shows.

The further we go with the investigation, the more we are struck with the close attention that is given to the external conformation of other animals (dogs, cattle, sheep and swine) by the compilers of herd books and others, while the conformation of the horse is largely left to the hap-hazard fancy of the observer; in view of this it has been thought advisable to incorporate a scale of points (in a future bulletin upon the subject) for the different classes of horses which are on the market for sale, or in the show-ring for exhibition. Any scales of points that have been brought under our notice have hardly covered as much ground as we think necessary, and while we feel that those we have drawn up are far from perfect, yet they furnish more food for thought than any we have seen.

In order that the admirers of the individual classes may express their views upon certain points of excellence, this advance bulletin is projected with scales of points arranged in accordance with the ideas of the writer, at the same time with the request that those who are interested in the production of better horses, or in aiding beginners in the work of selection, will make such alterations or additions as to them may seem proper, and by so doing they will assist in the formation of a scale of points which, coming from many who are intimately concerned, may be looked upon in the future as authority.

In preparing these scales the terms haunch or *upper thigh*, and gaskin or *lower thigh* have been introduced because authorities in anatomy differ so much as to the situation and limits of the haunch and thigh. It is to be hoped the plan we have adopted will make description less confusing.

In drawing up the scale, more might be said with regard to size and shape of different joints, but as proper action demands properly formed joints, it was thought if they were not right, the discount for their ill-shape would be made when the individual's style and action were up for discussion, and thus the scale card will be less encumbered with words.

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It is the intention to have our next bulletin illustrated in a manner that the various points of excellence, as well as other features, may be the more easily understood and a more or less detailed description of individual parts, with measurements of some well known horses, showing the diameters, length and breadth of them.

In these days of electricity and other motors for rapid transit, etc., the horse breeding industry is threatened with annihilation in some of its branches unless better animals can be produced. We must have stronger draft horses, more agile saddle horses, and faster roadsters, to save our distance in the struggle for existence.

Breeders as well as equine educators must be up and doing, and with the exercise of proper intelligence it is to be hoped *the horse* can hold his own against all competitors; therefore "no stone should be left unturned" that is likely to aid in the improvement of this animal.

CONFORMATION SCALE OF POINTS FOR THE COACH HORSE—STALLION.

HEAD—*Ear* fine, not too large, *forehead* broad and flat, *bones of nose* straight and dished on lateral surface, *cheek* muscle well developed, *eye* prominent, *nostrils* flexible, *mouth* not too deep	5
NECK—*Crest* well developed, neck itself being lengthy and properly muscled to carry head well	5
WITHERS—Well developed, *back* straight, loins broad	5
CROUP—Only moderately sloping, *dock* coming out high up, the *tail* well carried	5
CHEST—Well ribbed up, deep from above downwards, full in the bosom, *ribs* well sprung	5
SHOULDER—Moderately sloping, fully muscled	5
FOREARM—*Muscles* well developed and standing boldly out	5
KNEE—Broad from side to side in front, deep from before backwards; should be critically examined for malformations	5
KNEE TO FOOT.—*Cannon* clean, broad from before backwards, with *skin* lying close to bone and tendon, *pasterns* moderately oblique and strong	5
FOOT—*Wall* moderately deep and strong, *heels* full and round, *frog* well developed, *sole* concave	5
HAUNCH OR UPPER THIGH—Muscles standing boldly out and well defined, hind quarters broad	5
GASKIN OR LOWER THIGH.—Well developed with muscles standing boldly out	5
HOCK—Broad from before backwards, thick and strong from side to side	5
HOCK TO FOOT—*Hind canons* clean, broader from before backwards, and flatter than the front ones, skin lying close to bones, *pasterns* oblique, but strong	5
FOOT—Smaller, with sole more concave than in front	5
COLOR—Bay, chestnut, black, brown, roan, with reasonable modifications (a good horse may be a bad color)	5
SKIN—Soft, mellow, loose, not like parchment	5
TEMPERAMENT—Docile, not sluggish, but energetic, free from nervousness	5
STYLE AND ACTION—Free and elastic, knee well bent, front feet lifted well off the ground when in motion, *general appearance* attractive	5
WEIGHT—Pounds, 1,100 to 1,400	5
HEIGHT—Hands 16 to 17	5

CONFORMATION SCALE OF POINTS FOR THE COACH MARE OR GELDING.

HEAD—Not so masculine looking as the stallion's, but of the same general outline	5
NECK—Clean cut, having crest well developed and wiry, *wind pipe* standing in relief from the muscles, showing the jugular gutter, well defined	5
WITHERS—More prominent than in the stallion, *back* straight, loins broad	5
CROUP—Slightly sloping, *hock* coming out well up, the tail well carried	5
CHEST—Well ribbed up, deep from above downwards, *ribs* well sprung	5
SHOULDER—Moderately sloping, thoroughly muscled over the blade bone	5
FOREARM—Muscles well developed and standing boldly out	5
KNEE—Broad from side to side in front, deep from before backwards; should be critically examined for malformations	5
KNEE TO FOOT—*Canon* clean, broad from before backwards, *skin* lying close to bone and tendon, *pasterns* moderately oblique and strong	5
FOOT—Moderately deep and strong, *heels* full and round, *frog* well developed, sole concave	5
HAUNCH OR UPPER THIGH—Muscles standing boldly out and well defined, hind quarters broad	5

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GASKIN OR LOWER THIGH—Well developed, with muscles standing boldly out.... 5
HOCK—Broad from before backwards, thick and strong from side to side..... 5
HOCK TO FOOT—*Hind canons* clean, broader from before backwards, and flatter than the front ones, skin lying close to bone and tendon, pasterns oblique, but strong..... 5
FOOT—Smaller with sole more concave than the front ones..... 5
COLOR—Bay, chestnut, black, brown, roan with reasonable modifications (a good horse may be a bad color)..... 5
SKIN—Soft, mellow, not like parchment..... 5
TEMPERAMENT—Docile, not sluggish, but energetic, free from nervousness..... 5
STYLE AND ACTION—Free and elastic, knees well bent, and feet lifted well off the ground when in motion, *general appearance* attractive..... 5
WEIGHT—Pounds 1,050 to 1,300..... 5
HEIGHT—Hands 15¾ to 17..... 5

CONFORMATION SCALE OF POINTS FOR THE DRAFT HORSE—STALLION.

HEAD—*Ear* somewhat short, but pointed, *forehead* broad, *nasal bone* straight, *eye* prominent, *muzzle* small, muscle of cheek well developed, lips firm, mouth of medium size..... 5
NECK—Inclined to be short, deep where it joins the body, surmounted by a good full mane, well muscled..... 5
WITHERS—In line with posterior part of the upper border of the neck, *back* straight, not too long, loins broad..... 5
CROUP—Loaded with prominent muscles, *tail* well carried..... 5
CHEST—Well ribbed up, breast broad and full..... 5
SHOULDER—Moderately straight, muscles covering the blade thoroughly developed 5
FOREARM—Large and well muscled..... 5
KNEE—Of good size and strong..... 5
KNEE TO FOOT—*Canon* may be well feathered on its posterior border, especially in the region of the fetlock, the tendon hard and not cut away under the knee, *pasterns* short and strong, some breeds should be free from feather..... 5
FOOT—Not too flat, frog well developed, heels full and round..... 5
HAUNCH OR UPPER THIGH—Heavily muscled, thick through the ham, hind quarters broad..... 5
GASKIN OR LOWER THIGH—Muscle strong and bone substantial..... 5
HOCK—Large and strong, free from puffy tumors..... 5
HOCK TO FOOT—Hind canon broad and flat, may be well feathered, some breeds excepted, especially in the lower part, skin lying close to bone and tendon, pasterns short and strong..... 5
FOOT—Smaller than the front one and sole more concave..... 5
COLOR—Bay, chestnut, black, brown, roan, gray, with reasonable modifications (a good horse may be a bad color)..... 5
SKIN—Soft, mellow, loose, not like parchment..... 5
TEMPERAMENT—Energetic, docile, not nervous..... 5
STYLE AND ACTION—General appearance attractive, good especially in the walking gait..... 5
WEIGHT—1,600 pounds and upwards..... 5
HEIGHT—16 hands and upwards..... 5

CONFORMATION SCALE OF POINTS FOR THE DRAFT MARE OR GELDING.

HEAD—Not so masculine looking as the stallion, *ear* rather short but pointed, *forehead* broad, *nasal bones* straight, *eye* prominent, *cheek* well developed, *lips* firm, mouth of medium size..... 5
NECK—Inclined to be short, deep where it joins the body, well muscled, good mane. 5
WITHERS—In line with the superior border of the neck, back short and straight, loins broad..... 5
CROUP—Well covered with prominent muscles, tail well carried..... 5
CHEST—Well ribbed up, barrel round and body close to the ground, *breast* broad and full..... 5
SHOULDER—Moderately straight, muscles covering the blade well developed..... 5
FOREARM—Large and well muscled..... 5
KNEE—Of good size and strong..... 5

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KNEE TO FOOT—Not cut away too much under the knee; *canon* short, flat, may be well feathered, some breeds excepted, pasterns short and strong 5
FOOT—Not flat, *heels* full and round, *frog* well developed and springy 5
HAUNCH OR UPPER THIGH—Thoroughly muscled, thick through the ham, hind quarters broad 5
GASKIN OR LOWER THIGH—Muscles strong and bone substantial 5
HOCK—Large and strong, deep from before backwards, and broad from side to side, free from disease 5
HOCK TO FOOT—Hind canon broad and flat, well feathered, except in some breeds, skin lying close to bone and tendons, *pasterns* short and strong 5
FOOT—Smaller than the front one, sole more concave 5
COLOR—Bay, chestnut, black, roan, brown, gray, with limited modifications (a good horse may be a bad color) 5
SKIN—Soft, mellow, loose, not like parchment 5
TEMPERAMENT—Docile, energetic, but not nervous 5
ACTION AND STYLE—Good, especially in the walking gait, general appearance attractive 5
WEIGHT—Pounds 1,500 and upwards 5
HEIGHT—Hands, 15¾ and upwards 5

CONFORMATION SCALE OF POINTS FOR THE THOROUGHBRED STALLION.

HEAD—Ears fine, not too large, approaching each other at the tips when thrown forward, *cranium* nicely rounded, *forehead* flat and broad, *eye* prominent and bold in expression, bones of the nose straight, but slightly dished on the sides, *nostrils* firm, but flexible, of large capacity when the animal is excited, lips firm, mouth not very deep, *muzzle* tapering and small, *cheek* clothed with well developed muscles towards its upper or back part, *branches of lower jaw* well spread apart behind 5
NECK—Clean cut and rangy, crest well developed and whip-cordy if animal is not fat, *jugular gutter* well marked, head attached to neck in an angular manner, rather of the obtuse order 5
WITHERS—Well developed, back straight, loins broad 5
CROUP—Rather long and somewhat sloping, but with dock coming out well up, tail carried in an arched and graceful manner 5
CHEST—Somewhat cone shaped with good, broad base behind, apex between the fore legs, where the animal may be excusably narrower in proportion than other breeds, the cavity should be deep from above downwards, especially at the girth, well ribbed up, the ribs having plenty of spring or well defined angles 5
SHOULDER—Oblique from above downwards and forwards, the blade bone being well clothed with muscle 5
FOREARM—Well developed, with hard muscles standing boldly out, and having to some extent grooves or lines of demarkation between them 5
KNEE—Broad from side to side and deep from before backwards, the bone forming the back part of it may be somewhat prominent, should be carefully examined for malformations and injuries 5
KNEE TO FOOT—*Canons* hard, flat and clean, little, if any, hair on posterior border (that is coarse hair), *fetlocks* free from disease, back tendons hard and whip-cordy, having well marked grooves between them and the bone, space between knee and fetlock short, *pasterns* somewhat lengthy, strong and oblique 5
FOOT—Rather smaller in proportion than other breeds, round, deep, strong wall, full heels and well developed frog, sole concave 5
HAUNCH OR UPPER THIGH—Formed of well developed, hard muscles, showing marks of demarkation between them 5
GASKIN OR LOWER THIGH—Hard muscles standing boldly out, ham string well defined and cordy 6
HOCK—Deep and strong, free from puffy tumors, of the angular order but not curby 6
HOCK TO FOOT—*Hind Canon* short, flat, clean, rather oblique from above downwards and forwards, skin lying close to tendon and bone, *fetlocks* of good size and healthy, *pasterns* oblique, but strong and lengthy 5
FOOT—Smaller, not so round as front one, sole more concave 5
COLOR—Bay, chestnut, brown, grey, with reasonable modifications (a good horse may be a bad color) 5
SKIN—Soft, mellow, loose, not like parchment, hair forming coat, fine, silky, straight, hair of mane and tail, although coarser, should be soft, straight and fine in comparison with other breeds 5

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TEMPERAMENT—Not vicious but energetic, inclined to be impetuous 5
ACTION AND STYLE—Prompt, free and elastic, not too much knee action, but going rather close to the ground, especially in the gallop, good walker 5
WEIGHT—Say pounds, 1,050 to 1,300 5
HEIGHT—Say hands 15½ to 16½ 5

CONFORMATION SCALE OF POINTS FOR THE THOROUGHBRED MARE OR GELDING.

HEAD—Rather small, ear fine and pointed, not too long, *cranium* nicely rounded, *forehead* flat and broad, eye good size and gentle in expression, *nasal bones* straight, but slightly dished on the sides, nostrils firm, but flexible, of large capacity, *lips* firm, *mouth* not too deep, *muzzle* tapering and small, cheek clothed with well developed muscles, *branches* of lower jaw well spread apart behind 5
NECK—Clean cut and rangy, crest well developed and cordy, the point where neck leaves off to be well marked and in front of the withers, *jugular gutter* plain, wind pipe standing out independently of the rest of the neck, attachment of head to neck well marked and to be rather angular, of the obtuse order 5
WITHERS—Well developed, forming a well marked prominence over the shoulder, the top of which should not be thick, the back, springing from posterior aspect of the withers, should be straight and short, loins broad 5
CROUP—Rather long and somewhat sloping, but with dock coming out well up, tail carried in an arched, graceful manner 5
CHEST—Somewhat cone shaped with good, broad base behind, apex rather narrow, but deep through the girth, well ribbed up, the ribs having plenty of spring or well defined angles 5
SHOULDER—Coming from high withers should be oblique from above downwards, blade bone well clothed with muscle 5
FOREARM—Well developed with hard muscles standing boldly out, and marked from one another by grooves 5
KNEE—Same as the stallion 5
KNEE TO FOOT—Same as the stallion 5
FOOT—Same as the stallion 5
HAUNCH OR UPPER THIGH—Same as the stallion 5
GASKIN OR LOWER THIGH—Same as the stallion 5
HOCK—Same as the stallion 5
FOOT—Same as the stallion 5
COLOR—Same as the stallion 5
SKIN—Same as the stallion 5
TEMPERAMENT—More docile than the stallion, but still energetic 5
ACTION AND STYLE—Rather lighter on foot than the stallion, in other respects about the same 5
WEIGHT—Say pounds 850 to 1,200 5
HEIGHT—Say hands 14¾ to 16½ 5

The saddle horse may be of the same general type as the thoroughbred, mare or gelding, good manners, a mouth that responds readily to the desires of the equestrian, graceful and elastic action in all paces being essential features in animals of this class. Good saddle horses are, to a large extent, made, not bred.

CONFORMATION SCALE OF POINTS FOR THE TROTTING BRED STALLION.

HEAD—Ear of medium size and pointed, *eye* large, prominent and of docile expression, *forehead* broad and flat, *nasal bones* straight and dished on their lateral surfaces, *cranium bones* nicely rounded, *nostrils* firm, large and readily dilated, cheek muscles well developed, mouth not too small, muzzle fine and tapering, *branches* of lower jaws well spread apart at their angles 5
NECK—Rangy with well developed crest and attached to the head in an angular sort of way, rather of the obtuse order 5
WITHERS—May be continuous with the superior border of the neck, back straight, loins broad 5
CROUP—Somewhat sloping with dock coming out high up, tail carried in an arched and graceful manner 5
CHEST—Deep through the girth, breast broad and bosom well developed, well ribbed up and *ribs* well sprung 5

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SHOULDER—Oblique from above downward and forwards, blade bone well clothed with muscles 5
FOREARM—Well developed with large muscles standing boldly out 5
KNEE—Strong, broad from before backwards 5
KNEE TO FOOT—Not cut away under the knee, *canon* short, flat, hard and broad, not feathered, fetlock well formed and free from disease, pasterns moderately long and oblique, but strong 5
FOOT—Of medium size, wall strong and circular in outline, *heels* full and round, *frog* well developed 5
HAUNCH OR UPPER THIGH—Muscles well developed, quarters broad, ham thick 5
GASKIN OR LOWER THIGH—Muscles well developed, ham string prominent 5
HOCK—Deep from before backwards, broad from side to side, healthy 5
HOCK TO FOOT—*Hind Canon* short, broader and flatter than in front, little, if any coarse hair on posterior border, fetlock of good size and sound, pasterns oblique, strong and medium length 5
FOOT—Smaller, not so round, sole more concave than in front 5
COLOR—Bay, chestnut, black, brown, roan, grey, with reasonable modifications (a good horse may be a bad color) 5
SKIN—Soft, mellow, loose, not like parchment 5
TEMPERAMENT—Docile, prompt, energetic, not nervous 5
ACTION AND STYLE—Free and elastic, perfect in the trotting gait and good walker 5
WEIGHT—Pounds 950 to 1,200 5
HEIGHT—Hands 15½ to 16¾ 5

The mare and gelding of the trotting class may be of the same general type as the stallion, but not so masculine looking; the neck, withers and general physiognomy being the points which contribute most to the more effeminate appearance of these animals. The neck should be more delicate and cleaner cut, the withers more pronounced and not as thick through and through at the upper part; the physiognomy milder and more gentle and less impetuous.

EDUCATIONAL SCALE FOR HORSES SHOWN UNDER SADDLE OR IN HARNESS.

Prompt response to all aids imparted by the hand, the reins, the whip, the heel, the voice or whatever else may be used in directing the movements of the animal 10

HEALTH SCALE OF POINTS.

Soundness from a practical point of view, freedom from vicious habits, gibbing, cribbing, wind sucking, weaving etc., etc 10

HISTORICAL SCALE OF POINTS—FOR REGISTERED ANIMALS ONLY.

From Wallace's Monthly, August, 1887.

A. PEDIGREE—This is the most important single point in the whole scale (*scale in Wallace's Monthly*), and yet it is the one that has received the least attention. Consider well what the sire and dam have each inherited, what each has done as a performer, and what each has produced in the stud. Then consider the qualifications to two grandsires and the granddams in the same way. If the animal under judgment is running bred, consider the running qualities of his ancestors, but if trotting bred, look only to the trotting qualifications. The value of the pedigree is in the merit of the immediate crosses, viewed in the light of inheritance, performance and production 50

B. PERFORMANCE—Ability to perform well compensates for shortcomings in inheritance. Nothing but technical *records* can be accepted on this point. Any record is better than no record. Every animal intended to produce trotters should have his or her speed developed to some extent. The character and precision of the gate, with freedom from all artificial appliances, must enter into the value of this point 50

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C. CHARACTER OF OFFSPRING—This point applies only to aged and tried sires and dams. The credits will be awarded according to the number and class of fast performers from a given animal, the age and opportunities of the competitors being considered 50

[*N. B.—Points B and C are alternative; exhibitors shall elect one or other, but not both; perfection in each is 50.*]

In educational work the question often arises as to the best method of teaching a student how to judge a horse, but in this matter as well as other practical operations there can be little doubt that the best way to learn how to do a thing *is to do it*, and on this plan the best way to learn to judge a horse is to judge them. To begin with, the student must first of all make himself familiar with the various points of the horse, then make measurements on a plan similar to the following card. After measuring say ten horses according to this method, one will no doubt notice that his power of observation has become much more acute, which may be still further sharpened by scaling animals according to the plan suggested in this bulletin, or some other more acceptable one.

Measurements made with the tape line must be accepted with some little reserve, because we are often measuring from one imaginary point to another, and in taking circumferences the attitude of the animal modifies the size to some extent. All measurements should be made with great care, in order to have them anything like accurate.

Points to be measured from and to are indicated by dotted lines and numbers—see plates Nos. 2 and 3. One or two points are so self-evident that they are not marked.

PROPORTIONS OF THE HORSE.

Name of the animal..... Class..... Color..... Age..... Sex.....
..... Owner..... P. O.....

Weight.

Plate 3, Fig. 1, 1.1 —Height at the withers.
" 3, " 1, 2.2 —Length from point of shoulder to quarter.
From the lowest point of the chest to the ground.
" 3, " 2. 3.3 —From the point of the elbow to the ground.
" 3, " 1, 4.4 —From the point of the elbow to the trapezium.
From the trapezium to the ground.
" 3, " 1, 5 —Circumference of the arm.
" 3, " 2, 6 —Circumference of the canon in the center.
" 3, " 2, 7 —Circumference of the foot at coronet.
" 3, " 1, 8 —From the highest point of the withers to crest of occiput.
" 2, " 1, 2½.2½—Width of forehead. Plate 3, Fig. 1-9, length of head.
" 3, " 1, 10 —Circumference of muzzle at angle of mouth.
" 2, " 1, 6.6 —Width of chest from outside of shoulder points.
" 3, " 2, 11 —Length of back from highest point of the withers to a line between the points of the hips.
" 2, " 2, 13.13 —Width across the hips.
" 3, " 1, 12.12 —Height at the highest point of the croup.
" 3, " 2, 13.13 —From the center of the dock to anterior point of patella.
" 3, " 2, 14.14 —From point of hock to point of hip.
" 3, " 1, 15.15 —From point of hock to ground.
" 3, " 2, 16 —Circumference of thigh.
" 3, " 2, 17 —Circumference of shank midway between hock and fetlock.
" 3, " 2, 18.18 —Circumference of body at the girth.

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Consulting Veterinarian to the Michigan Experiment Station.

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A YEAR WITH BEES.

Special Bulletin No. 1.—Apiary Department.

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SUMMARY.

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I was plunged into the midst of the work of the station at the most important as well as the busiest season of the year, by an appointment as agent only a short time before the opening of the main honey season — an appointment which I had previously not the remotest thought of receiving —and so no doubt many of the methods pursued may prove cruder than they might have been had I had the advantage of time for previous thought directed to the maturing of plans best calculated to secure the clearest results in the experiments looking to the solution of questions that are of especial interest to bee-keepers; indeed I now see many points wherein the plans pursued may be improved upon in future experimental work. It is to be noted also that thus far I have been left to my own resources for the selection of subjects for investigation, but it is hoped that the steps recently taken by the State Bee-Keepers' Association in the appointment of a committee to assist in determining the points most likely to yield results of the highest advantage to apiculture may give additional value to the work.

USE OF FOUNDATION IN THE BROOD-CHAMBER.

Under this head I shall set forth the character and results of the experiments made in the apiary to test the comparative value of comb, foundation and starters when used in the brood chamber for swarms, and in addition thereto to call attention to what the experiments seem to

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disclose touching the comparative advantage of swarms of different sizes. In the main all this can be best accomplished by the use of tables which I have prepared and which are presented herewith.

It was not till the 27th of June that I was able to put into operation my plans for making these tests. I prepared twelve hives, four of which were furnished with comb, four with foundation, and four with starters only. The hives prepared with comb were designated by the numbers one to four inclusive with the letter A, those with foundation in like manner with the letter B, and those with starters with the same numbers and the letter C, and each hive was marked with the proper designation and its weight. Then in each case when a swarm issued, which was to be used for making this test, it was secured in a basket and weighed before hiving; the supers also, whether taken from the old hive at the time of swarming or supplied subsequently, were carefully weighed before they were put in place and a record made on the spot of all items. By referring to table A all these will be found in the three columns following the date of hiving except of course the weight of the cases subsequently adjusted, which appears further along. I ought also to say that in each case the hive with the bees and cases was re-weighed early on the morning subsequent to the hiving in order to detect and thereby correct any change which might chance to take place before the swarm became settled in its new home. The only change it was found necessary to make was the addition of the fraction of a pound to the weight of the bees, which may be supposed to be accounted for by the presence in the morning of bees which at the time of swarming were afield.

Other data for table A were obtained by weighing the several hives, bees, supers and all upon three different dates, viz., the 6th, 12th, and 19th of July (thus dividing the time of the test into three nearly equal periods), and by weighing the cases of honey separately on July 19, at the end of the time given to the test. These data with the previous ones enable me to state the exact total gain of each colony for each of the three periods, the gain of each colony in the amount of comb honey, together with the gain in the weight of the hive for the entire time. From these I deduce the gain per pound of bees of each colony for each of the three periods as well as for the entire time, and also the gain in the weight of the hive and the gain in the amount of comb honey for the whole time.

It will be noticed by reference to the tables that almost nothing has been made of 3A and 2C. The explanation of this is that the latter persisted in its desire to swarm until it eventually lost a considerable part of its bees by their uniting with another swarm and the former, within a day or two after swarming, in some way lost its queen and dispersed more or less in consequence. The only question with regard to the propriety of this course arises when we consider table C wherin the comparative advantages of large and small swarms are weighed. Perhaps 2C should have been permitted to cut some figure in that for it clearly illustrates one of the advantages of very large swarms.

Table B is a summary of table A and puts the tables of each group of colonies employed in the experiment side by side so that the general results are seen at a glance.

Table C is derived from table A and puts in contrast the work of the stronger colonies of each group with that of the weaker ones of the same group, and table D is an epitome of table C.

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Table A.

	Hived on designation.	Hived June.	Wt. of hives, pounds and ounces.	Wt. of cases.	Wt. of bees.	Total weight at time of hiving.	Total weight July 6.	Total gain 1st period.	Gain per lb. of bees lbs.	Wt. of cases adjusted July 6.	Total weight July 13.	Total gain to July 13.	Total gain 2d period.	Gain per lb. of bees, 2d period.	Total weight July 19.	Total gain to July 19.	Total gain 3d period.	Gain per lb. of bees, 3d period.	Wt. of cases July 19.	Total gain in comb honey.	Total gain in comb honey per lb. bees.	Total gain in wt. of hives.	Gain in hives per lb. of bees.	Total gain per lb. of bees.
Comb.	1 A	27	19 8	11 4	7 12	38 8	69	30 8	3.925	9 8	87 4	39 4	8 12	1.129	95 4	47 4	8	1.032	55 12	35	4.516	12 4	1.58	6.096
	2 A	27	16 4	24 4	7 8	48	80 8	32 8	4.333	.....	93	45	12 8	1.666	108 8	60 8	15 8	2.066	62 12	38 8	5.133	22	2.933	8.066
	3 A*	29	19	21	3	43	48 8	*5 8	1.833	.....	49 8	6 8	*1	.....	52 4	9 4	.....	.....	19 12	.....	.....	.....	.....	.....
	4 A	29	19	14 4	5 8	38 12	53	14 4	2.591	.....	68	24 4	10	1.818	72	33 4	9	1.636	31	16 12	3.045	16 8	8.	6.045
								77 4					31 4				32 8			90 4		50 12		
F'd'n.	1 B	27	15 8	28 12	7 8	51 12	82 8	30 12	4.1	8 12	104	43 8	12 12	1.7	118 8	58	14 8	1.933	88	50 8	6.733	7 8	1.	7.733
	2 B	27	15 8	53	7 4	75 12	105	29 4	4.034	7 8	129	45 12	16 8	2.275	134 8	51 4	5 8	.758	102 4	41 12	5.758	9 8	1.31	7.068
	3 B	28	17	5 8	5 4	27 12	39 12	12	2.285	.....	49 8	21 12	9 12	1.857	55 4	27 8	5 12	1.095	18	12 8	2.388	15	2.857	5.237
	4 B	29	15 8	6 12	4	26 4	35 12	9 8	2.375	.....	48 4	22	12 8	3.125	56	29 12	7 12	1.937	21 4	14 8	3.625	15 4	3.812	7.437
								81 8					51 8				33 8			119 4		47 4		
Start-ers.	1 C	27	16 8	5	7 8	29	46 4	17 4	2.3	8	66 8	29 8	12 4	1.633	75	38	8 8	1.138	46	33	4.4	5	.666	5.066
	2 C*	27	16 12	19 8	10 12	47	57	*10	.93	.....	65	18	*9 12	.....	69 8	22 8	4 8	.....	45 4	25 12	.....	.....	.....	.....
	3 C	29	16	15 8	5	36 8	47 8	11	2.2	8 4	67	22 4	11 4	2.25	77	32 4	10	2.	46 4	22 8	4.5	9 12	1.95	6.45
	4 C	29	15 8	7 8	4 4	27 4	86	8 12	2.058	.....	49 8	22 4	13 8	3.176	59 12	32 8	10 4	2.411	21 8	14	3.294	18 8	4.352	7.646
								37					37				28 12			69 8		33 4		

* 3 A and 2 C are disregarded in subsequent tables.

Table B.

Description of swarms.	Wt. of bees in lbs. and ounces.	Gain first period.	Gain per lb. of bees.	Gain second period.	Gain per lb. of bees.	Gain third period.	Gain per lb. of bees.	Gain comb honey.	Gain per lb. of bees.	Gain in wt. of hives.	Gain per lb. of bees.	Total gain.	Total gain per lb. of bees.
Group A	20 12	77 4	3.722	31 4	1.506	32 8	1.566	90 4	4.349	50 12	2.445	141	6.794
Group B	24	81 8	3.395	51 8	2.145	33 8	1.395	119 4	4.968	47 4	1.968	166 8	6.936
Group C	16 12	37	2.208	37	2.208	28 12	1.706	69 8	4.15	33 4	1.97	102 12	6.12
Table C.													
Group A { Swarms of over 7 lbs.	15 4	63	4.131	21 4	1.393	23 8	1.541	73 8	4.819	34 4	2.245	107 12	7.065
Group A { Swarms of less than 6 lbs.	5 8	14 4	2.591	10	1.818	9	1.636	16 12	3.045	16 8	3.	33 4	6.045
Group B { Swarms of over 7 lbs.	14 12	60	4.065	29 4	1.968	20	1.355	92 4	6.254	17	1.152	109 4	7.406
Group B { Swarms of less than 6 lbs.	9 4	21 8	2.324	22 4	2.405	13 8	1.459	27	2.92	30 4	3.27	57 4	6.189
Group C { Swarms of over 7 lbs.	7 8	17 4	2.3	12 4	1.633	8 8	1.133	33	4.4	5	.666	38	5.066
Group C { Swarms of less than 6 lbs.	9 8	19 12	2.078	24 12	2.606	20 4	2.181	36 8	3.842	28 4	2.978	64 12	6.815
Table D.													
Total of swarms of more than 7 lbs.	37 8	140 4	3.728	62 12	1.671	52	1.386	198 12	5.3	56 4	1.5	255	6.8
Total of swarms of less than 6 lbs.	24	55 8	2.312	57	2.375	42 12	1.781	80 4	3.342	75	3.125	155 4	6.468

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Now what do the tables teach with regard to the comparative profit of the use of starters, foundation, and comb in the brood chamber as well as with regard to the advantage of larger and smaller swarms? It would be too much to expect that upon either of these points the results shown by the several hives taken separately would invariably point in the same direction. There are so many inscrutable influences at work that we may well look for unexplainable vagaries in the revelations of individual hives. It it largely for this reason that I think the writer who in one of the apicultural journals recently very flatteringly intimated that the results obtained in the experiments at this branch of the Michigan experiment station would be conclusive, was hasty. If several varieties of wheat, for instance, were sown side by side upon precisely the same kind of soil so far as human skill could determine, and each variety should receive exactly the same treatment in all respects and at the same time, and one certain variety was found to yield twenty per cent more than any other, yet the farmer who should from the one experiment jump to the conclusion that the result would always be the same would be accounted lacking in judgment. The results must be verified repeatedly before they can be accepted as the rule. Just so it is with the matter in hand. Yet the multiple character of our experiment with results so nearly uniform give strong assurance that what seems to be disclosed is in the direction of the truth.

From the figures given in the last column of table B, we find that the colonies hived on comb gained in all more than eleven per cent over those hived on starters, and that those hived on foundation gained more than thirteen per cent over the same. But if we examine with reference to *comb honey* only, we find that colonies "A" (those on comb) gain less than five per cent more than colonies "C" (those on starters), while colonies "B" (those on foundation) gain more than seventeen per cent over "C." But it may be said that "C" has an undue proportion of the weaker colonies, which is true; still, if we turn to table C and consider only the strong swarms in each group, we find that "A" gains nine and one-half per cent more than "C" in comb honey, and "B" gains forty-two per cent more than "C!" But, strange to say, taking the light swarms in the same table and column, the positions are exactly reversed, "A" gains nearly one-half of one per cent over "B," while "C" gains nearly thirty-two per cent over "B." It would be interesting to inquire why the difference in the weight of the colonies should cause this reversal in their positions in regard to the amount of comb honey produced.

Referring again to table B from the figures given in the third column, where the gain for the first period is given, we deduce that "B" gains during that period more than fifty-three per cent over "C," while "A" gains more than sixty-eight per cent over "C," but during the second period the figures show that for that period the positions are exactly reversed, while for the third period the positions as to relative gain are again changed, "A" making a spurt and leaving "B" in the rear. Referring again to table "C," we find that the strong colonies invariably gain the more in the first period, while the light ones take a decided lead both in the second and the third periods; in the amount of comb honey for the entire time in each group, the strong colonies have a decided advantage, and so in groups "A" and "B" in the amount of total gain, but in group "C," in this point, the weaker ones are far in the lead. But this sort of comparison might be carried on almost endlessly.

If we examine table "A" we find, as was to be expected, that the results

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in the cases of some individual colonies do not always accord with the general results, yet sufficiently so, I think, to warrant us in putting some confidence in the general results so far as they go; I say so far as they go, for the test was for three weeks only and *time* appears to be an essential element in the experiment. The colonies that are strong in numbers as compared with the weak, and those aided with comb or foundation as compared with those left unaided, are soonest *out of breath* in the race, or, perhaps, the luxury and wealth of numbers and resources prove destructive to energy and ambition; and, on the other hand, straitened circumstances whether it be from a lack of numbers or of resources, arouse vigor and persistence in a determination to supply the lack. At least, that is what the tables seem to teach, and we can only guess what the result would have been had the tests covered the whole of the honey season instead of the last half. Many and varied experiments must be made in order to arrive at the exact truth in these matters. The more important results which are pretty clearly disposed by the series of experiments conducted in the manner and for the time stated will be found in briefer form in the following

SUMMARY.

In this summary, as elsewhere, when I speak of gain it is not gain per colony, for the colonies vary in strength, but per pound of bees, which seems to be the only just way.

If then we may trust our tables, they show for the last half of the summer honey season:

1. That for profit, foundation in the brood chamber for swarms has a decided advantage in point of surplus comb honey over both drawn comb and frames with starters only; that drawn comb stands second and starters third.
2. That in point of total gain in both brood chamber and surplus the same order holds and to nearly the same extent.
3. That fairly strong colonies show a very decided advantage over light ones in point of comb honey surplus, and also to a small extent in the total gain.
4. That light colonies sustain their rate of gain in all cases better than fairly strong ones.
5. That swarms on starters only sustain their rate of gain decidedly better than do those on comb or on foundation.
6. That of the light colonies those on starters are decidedly more profitable than those on either comb or foundation.

I ought to explain here that each swarm was hived on a brood chamber equal to that required to hold five L combs.

Before these results are accepted with absolute confidence further experiments are, of course, necessary. During the progress of the work also several points have been suggested in which the plan of the experiments might be so changed as to give increased reliability to the results. For instance, it is well established that the working powers of different colonies greatly vary, thus introducing an element of uncertainty into the results. This uncertainty may be eliminated in future experiments by uniting each set of three swarms, first caging their queens, and after they have thoroughly coalesced, then dividing them into three equal parts, giving to each one of the set of hives prepared as before explained.

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Again, instead of giving the swarms supers, taken from the old hives with sections partly filled, it would probably give an added value to the results if the experiment were varied by giving some sets of the new colonies supers untouched by the bees.

The results so far attained indicate that it may be of the highest importance that, in part, early swarms should be used in making this experiment an intimation to which heed ought to be given.

FEEDING HONEY FOR THE COMPLETION OR SECTIONS.

At the end of the white clover honey season, finding I had a large number of unfinished sections on hand, as well as honey to extract, I planned to make an experiment in feeding back extracted honey to secure the completion of the sections. The experiment was begun about the last week in July and was continued for about four weeks. This was too long a time for the amount of work done. This is to be accounted for partly by the weather during August, which was characterized by unusually cool nights, and partly by the fact that some of the colonies used were not so strong as they should have been. I also think that the feeders used were partly to blame. They were Heddon feeders brought from the Agricultural College. It may be they were not properly made, at all events when I came to feed for winter I found I could feed half a dozen with a tin pan to one with one of those feeders.

The only preparation of the colonies to be used was, where they were not already confined to one section of the Heddon hive, to so confine them by removing the extra sections of the hive containing the least brood.

Number.	Weight of sections put on.	Amount fed.	Amount removed.	Gain.	Per ct. of gain of amount fed.	Weight of hive at beginning.	Weight of hive at end.	Gain in weight of hive.	Loss in weight of hive.
1	115	136-8	202-8	87-8	64.2	39-4	38-12	.....	0-8
2	73	111	137-8	64-8	59.9	27-8	36-12	9-4	.....
3	97-12	116-12	165-4	67-8	57.8	27-8	36	8-8	.....
4	103-4	114	164	60-12	53.2	28	38-12	10-12	.....
5	43-8	85-8	92-8	49	57.3	29-8	41-12	12-4	.....
6	48-4	80-8	83-12	35-8	44.1	24-8	41-4	6-13	.....
7	107-12	144-8	206-12	98	67.8	26-12	39	12-4	.....
Total	588-8	788-8	1051-4	462-12	58-6	213	272-4	59-13	0-8

It is hardly necessary to say that after this the cases of sections to be furnished were put upon the brood chambers as needed and the feeder placed above the sections. The feeders were then kept continually supplied with the extracted honey without dilution.

Seven colonies were employed and an accurate account kept of the material in the case of each colony. The results may be most briefly told by the use of a table as shown on the preceding page.

But little need be said in explanation of the table. On the average out of every 100 pounds fed 58 6-10 pounds reappeared in the shape of comb honey. Some colonies did much better than that. In selecting colonies some not very strong were taken to make the fact prominent that for the

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best results the very strongest should be chosen. This fact of employing some colonies not very strong, with others already mentioned, make the circumstances of this experiment about as unfavorable as they could ordinarily well be, yet there seems to be no difficulty in showing a large percentage of profit.

To show this I think we may properly make the calculation in this way:

Increased value of 588 lbs. 8 oz. of unfinished section honey at 7c	$41 19
Value of 426 lbs. 12 oz. "gain" at 15c	69 41
Increased weight of brood chambers 59-4 at 5c	2 90
Total	$113 56
Deduct value of 788 lbs. 8 oz. fed at 8c	63 48
Profit	$50 08

This does not take account of the labor of feeding, but I think the improved condition of the colonies may well offset that item.

There is one drawback with this product—it is liable to candy and so makes it necessary that it be disposed of and consumed without much delay. Perhaps on account of this defect I have estimated the value at too high a figure. If some unobjectionable method of preventing candying could be found it would be a great advantage.

To attain the highest success in feeding back for the purpose indicated, the honey should be considerably diluted— say one part of water to two of honey—and feed as warm as possible, without danger to the bees, not lower than 100 degrees F. The brood chamber should be contracted to a capacity of not more than five Langstrath frames. It is also indispensable that the work be done during hot summer weather if the best results are desired.

LANGDON'S NON-SWARMING ATTACHMENT.

This attachment is a device intended, as its name indicates, to prevent swarming. It is so constructed as to cover the entrances of two hives placed side by side. When in place the bees can make their exit or entrance only by passing through it. In the attachment is a slide so arranged that the entrance of either hive is closed by it at the pleasure of the operator, the entrance to the other being opened by the same operation. When the entrance to a hive is closed there is still a passage for exit only, so the bees go out but return to the hive with the open entrance. The theory is that the closed hive becomes so depleted of bees that all desire to swarm is eradicated; in five or six days the slide is made to close. The other hive, now overflowing with bees, before it is prepared to swarm, thus preventing its swarming by throwing all the field bees to the hive depleted five or six days before. In five or six days the change is again made, and so on, regularly, the supers being changed each time to the hive that is to contain the working bees.

Five of these attachments were adjusted to hives on the 22d day of June, and that the conditions may be understood as fully as possible, I must explain that at that date swarming to a moderate extent had been going on in the apiary for a week or ten days. The hives employed also varied in capacity, three sizes being used, viz., the single story, new Heddon, double story new Heddon, and the eight frame dovetailed. The hives of

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course are used in pairs and for convenience each pair is designated by a number. Nos. 1 and 5 were each composed of one double and one single Heddon, No. 2, of two single Heddon, No. 3 of two double Heddon and No. 4 of two dovetailed hives. I wish to explain here also once for all that in this line of experiments wherever a swarm issued it was never returned to the hive from which it came, but always to the other member of the pair. The details of the swarming are as follows: No. 1 cast a swarm June 24, 28, 30, and July 4 and 10, five times; No. 2 cast a swarm June 23, 24, 25, and 26, and July 1, 4 and 7, seven times, No. 3 cast a swarm but once, on June 30; No. 4 cast a swarm June 27 and July 2, twice; No. 5 cast a swarm June 24, 26, and 29 and July 4 and 10, five times. In other words, No. 1, consisting of one single and one double story Heddon hive, swarmed five times, three times from the single story and twice from the double story; No. 2, consisting of two single story Heddon hives, swarmed seven times; No. 3, consisting of two two-story Heddon hives, swarmed once only; No. 4, consisting of two dovetailed hives, swarmed twice; and No. 5, consisting of one single story and one double story Heddon, swarmed five times—three times from the single and twice from the double story—that is, it appears, the larger the hive, the longer are the bees able to resist the inclination to swarm.

It will be observed that there was little opportunity to operate the attachment for the purpose of throwing the bees from one hive to the other (except as swarms issued) and it was only practiced in the cases of Nos. 3 and 4, twice in No. 3 and once in No. 4. In each of these this was done on June 26, the fourth day after the attachment was put in place. But it will be noticed that the very next day, June 27, No. 4 cast a swarm and No. 3 cast a swarm on the 30th, indicating that when other conditions are favorable, very little, if any, preparation at all in the way of queen cells is required before the bees feel at liberty to swarm.

One hive of No. 2 lost its queen which was replaced by a fine young queen which had been laying but a few days, yet this young queen came out with a swarm within four days, and within a week was lost, apparently destroyed by the bees.

As might have been expected under such circumstances the bees of these colonies did not do very good work, but those that did the most swarming did fully as well as the others. As I estimate it, these bees yielded about 65 to 75 per cent of the surplus they would have yielded had they been managed in the ordinary way. What especially surprised me was the remarkable slowness shown by these strong colonies in capping their surplus honey.

It was always very evident that the desire to swarm was thoroughly eradicated from the colony from which the bees had been thrown—this was frequently very soon shown by the casting out of immature drones. I could not see that the worker brood suffered materially.

Why was it that the inclination to swarm was not also removed for a imet from the working force of the two colonies thrown together into a hive in which there was no beginning of preparations for swarming?

I have hereinbefore remarked that it appears that the larger the hive the longer the bees are able to resist the inclination to swarm. But the size of a hive is a relative matter and the largest one becomes small if too many colonies are united and put into it.

The theory of the Langdon attachment is that the prevention of the completion of the usual course of preparation for swarming common in

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normal cases will prevent swarming in all cases. The mere statement reveals the fault in the reasoning. The attachment answers completely to the theory, but the theory is wrong. It is not an infrequent occurrence that swarms issue without leaving a sign that there had been a thought of preparation, and this is only on the line between the normal and the abnormal. If several swarms are out at once and unite and are hived after an unequal division the colony having an unduly large proportion of the bees will generally persist in the desire to swarm. That condition is abnormal and creates dissatisfaction. To unite the working force of two strong colonies when the swarming fever is in the air is highly abnormal, and if this is done, this abnormal condition must be provided against if swarming is to be prevented. At least the result of the experiments thus far seems to point that way.

If a course of operations creates abnormal conditions it should be required to make efficient provision to cope with those conditions.

THE AUTOMATIC HIVER.

The hiver is a device having for its object the doing away of the necessity for the presence and watchfulness of the apiarist in the hiving of swarms and the prevention of their escape. In brief, it is a board the size of a horizontal section of the hive, with openings through it so fitted with perforated zinc that the workers can pass freely either way, but so that the queen, in her effort to go out with a swarm, can pass down but cannot return. The hive intended for the swarm is placed on the stand, the hiver on its open top, and the hive containing the colony above the hiver. The lower entrance to the unoccupied hive is closed and the opening in the edge of the hiver serves as an entrance to either hive, but permits the passage of workers only. The theory is that when the colony casts a swarm, the queen, in her efforts to escape, passes below, and the swarm, when it misses her, returns to the hive, and finding her below, occupies that hive with her. There are hivers constructed on other plans, but the foregoing is a description of the one tested.

PRATT'S HIVERS.

The Pratt Hiver was the one included in my plan for a series of experiments to be conducted during the white clover honey season. Five of them were used, the first of which was put in place June 16 on a hive which I shall call No. 1, while a swarm from it was in the air. As the entrance to this hive was not guarded by a queen trap, and on queen being found in front of the hive as was to be expected, since I clip my queens, I put a trap to the lower entrance and caused the bees to enter through it that I might find and determine the character of the queen. The result was that I found two or three virgin queens, showing that the swarming was probably caused by the rearing of queens to supersede the old one or on account of her death. The young queens were removed and the trap left in place to enable me to determine the purpose of the next queen that should attempt to try the open air. A few days later a young queen was found in the trap, no swarm having issued. She accordingly was returned, the trap removed and the lower entrance left open for the convenience of the queen.

No. 2 hiver was adjusted June 17 upon the issuing and return of a

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swarm. After this adjustment the queen was of course in the old brood chamber, notwithstanding which, the swarm did not issue again until June 29, when it was allowed to return. On July 2 it again issued and became mingled with other swarms so that it was necessary in making a division to allot the proper portion which was returned to the hive. This colony, though furnished with a case of sections filled with well drawn comb, has done comparatively nothing in it. Upon the 13th of July it swarmed again, being the fourth time, but this time I discovered the queen was a virgin, showing that the old queen had probably been killed on the return of the swarm July 2.

The remaining three hivers were also put in place June 17.

No. 3 was the only other one of the five from which a swarm issued and from it, first, on the 20th of June. On the next day I found that the queen had been killed by the bees of the returned swarm, so a trap was placed at the lower entrance. After this a swarm issued on each of the following dates: June 30, and July 2, 4, and 8. In the last case the swarm was hived in another hive and given the queen in the trap. In all the previous ones the swarm was returned and the queen removed.

In studying results it should be remembered that these five colonies were of more than average strength and were selected on that account because I was anxious to test the hiver by actal swarming.

If the percentage of loss of queens in these experiments is to be taken in any way as a criterion of what it would be in general practice, quite a serious difficulty is presented to the practical working of the hiver, for it would mean the ruin of all colonies that throw off swarms unless constant watchfulness is exercised, and if there must be such watchfulness there would seem to be little necessity for hivers. Though I should not expect that the percentage of loss would be generally so large, yet I fear it would be sufficiently so as to be still a serious matter.

Of perhaps even greater interest than the loss of queens is the effect of the hiver upon the amount and value of the honey produced. At the time the hivers were adjusted all the colonies in question were working in the sections except No. 1, though no great progress had been made except in case of No. 3, which had nearly filled the first super of 28 sections. This was an exceptionally strong colony and was composed of excellent workers. Judging by what other colonies did it should have produced 75 pounds of comb honey had it been managed as the others were. In the same way the other four would have averaged about one-half as much, or 225 pounds for the five.

The actual results so far as comb honey was concerned were all contained in three cases, none of which were very well filled, certainly not to exceed 60 pounds all told, and this was all produced by No. 3 and by Nos. 4 and 5 which did not swarm. At once, on the close of the clover season, the extra hives—those not containing brood—were removed and would yield about 150 pounds of extracted honey. Even the colonies that did not swarm had pretty well filled the hives below the hivers.

Of course I appreciate the unsatisfactory character of the comparative result founded as it is upon an estimate of what the colonies would have done under other circumstances, but with a desire to arrive at the exact truth I have judged as fairly as I am capable of doing.

Until swarming has once begun the hiver has apparently a strong tendency to restrain the swarming fever, but when a swarm once issues, if the

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old queen is killed, the fever will generally persist till all the young queens but one are destroyed or otherwise disposed of.

Before a final determination as to the utility of the hiver, further tests must be made, and it is to be hoped that such further improvements may be made as may render the circumstances of future trials more favorable.

SMOKERS; BEE ESCAPES; BRACE AND BURR COMBS; CLEANSING WAX WITH ACIDS.

Smokers for use in apiaries to aid in the control of the bees are rightly considered a prime necessity. They are made in great variety by a number of manufacturers. Several tests have been made by different persons of the comparative powers of the "blasts" of some of the larger ones, but it occurred to me that perhaps that point is not the most important one to be considered, for the reason that for all practical purposes the blast of any of the well known smokers is strong enough,—in fact the use of a very strong blast is very seldom desirable. I think the points that should have precedence in determining the value of a smoker are: The degree of freedom from choking up, and durability and convenience in using, and these points can best be decided by practical use in the apiary. To compare in this way the two smokers that have perhaps the highest repute of any, viz., the Crane and the Bingham, I procured one of each of the largest size and put them to use in the apiary during the entire busy season.

So far as difficulty with soot was concerned neither one seemed to have any decided advantage—either being entirely satisfactory when proper fuel is used. The fuel should be wood absolutely dry and but little decayed; if fuel containing much dampness is used soot will collect sufficiently to cause some annoyance.

As to durability, one season is not sufficient to enable one to form a judgment. Barring accidents, the leather used in making the bellows is in an otherwise first-class smoker the first part to fail, so that in such case the one in which the best leather is used would generally prove to be the most durable. In the two smokers in question the leather used appears to far to be equally good.

In point of convenience my assistant decided that the Bingham had a decided advantage and in my judgment his decision was right. The wire handle for opening the fire box in the Bingham was found more effectual in securing the hand from burning in the operation of refilling, for the cap of the Crane, though lined with asbestos, would often become much too hot to be grasped by the hand with impunity; but more important than this we considered the difference in the weight of the two smokers. From the use of asbestos in the Crane smoker and the consequent doubling of the metal it is made much the heavier, which made it a burden where much use was to be made of it, and caused the Bingham in such cases to receive the preference. Where one has the management of but few colonies a smoker of one of the smaller sizes answers every requirement.

For the purpose of experiment I procured and put to extensive use in clearing supers of bees, a dozen bee escapes, a part of which were those known as the Porter and the rest the Hastings. There is no question that they are of great utility for the purpose intended at any time when the bees are not busy gathering honey from the fields. As a rule, about twenty-four hours were required to substantially clear the supers of bees,

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and then there were generally a few bees left in them, but not so many as to be a serious objection. They were not used until the honey season had about closed and it is very likely that had they been employed during the time of active work in the fields their function would have been much more rapidly performed. Though no very great difference appeared, yet of the two the Porter seemed to operate the more satisfactorily. It appears that the perforated plates have the effect of making the bees contented where they are, rather than hastening their departure from the super. Great caution should be exercised by the novice in adjusting the escape in seeing that the super is bee proof, otherwise he may discover later that he has instituted a disagreeable case of robbing.

For several years past there has been much discussion of the question of the prevention of brace and burr combs, and for the purpose of such prevention frames with heavy top bars have found much favor. During the past season, being possessed of fifteen or more colonies upon such frames, I had a favorable opportunity for judging of their effectiveness. The top bars of the frames I used are one and one-sixteenth inches wide and eleven-sixteenths inches deep. I spaced them about one-quarter inch apart so that they were about one and five-sixteenths inches from center to center. The results were very satisfactory, and, unless seasons of more abundant honey flow produce different results, leave nothing to be desired. There was scarcely a sign of a burr comb except where a frame was improperly spaced.

Having seen the use of sulphuric acid recommended for the cleansing of wax I procured some in order to test its efficacy. To do so I brought the wax to a hard boil, then dipped it into a wooden vessel and added about a tablespoonful of the acid to twelve pounds of wax. The wax, which before was very dark, was astonishingly improved in appearance. However, the process is one not to be recommended unless in extreme cases. The bringing of the wax itself to the required temperature demands extreme care to avoid danger, and the acid is a poison which must be handled with the greatest caution; and more than all this the wax is, undoubtedly, as Dadant points out, injured for the use of the manufacture of foundation and the price would be consequently lessened rather than increased if it is to be used for making foundation. It seems wiser therefore to render wax in the ordinary way and to make use of the acid process when the wax is very dark and is to be used for some other definite purpose than that of making foundation.

FOUL BROOD; ITS SYMPTOMS AND CURE.

During the season I have given considerable attention to the disease known among bee-keepers as foul brood which from its insidious, highly contagious and deadly character, is the one disease of the hive to be greatly dreaded by the apiarist. It no doubt attacks and greatly curtails the life and usefulness of the mature bee, but it is in the case of the bee in the larval state that its destructive effects are most evident. Like many of the diseases to which the human family is subject it is induced by bacteria to which, in this particular case, the name Bacillus alvei is given, and such is its malignity that when once present, unless proper measures are taken to keep it in check, in the course of three or four years whole apiaries are swept away. I am inclined to think that it is often present

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where not suspected and that often the destruction ascribed to the severity of the winter should be assigned to it.

How to detect the presence of the disease, and how to effect its cure, are the practical points to which my attention has been chiefly directed.

My experience with it is not confined to the past season, but runs back over the past seven years, during which I have cured more than one hundred cases largely during the first two years of the period, but I became so interested in the study of the disease and so certain that I could control it that I was not anxious to be entirely rid of it, preferring rather at some risk to get as thorough and practical acquaintance as possible with its peculiarities and with the best methods of dealing with it.

It would be important to know, if possible, all the ways in which the disease is conveyed from one colony to another. Whether the bacteria may be carried in the air to a new hive, or whether a bee from a diseased colony may carry them out on its feet or body and in gathering nectar deposit them on the flowers so that they may become by chance attached to another bee from a healthy colony in its visits to the same flowers, and thus become the means of spreading the disease, or whether a bee from a diseased colony will convey the disease if on returning from the field with a load of nectar it enter a hive not its own I know not, but there are numerous ways by which the disease may certainly be spread, which should be familiar to every bee-keeper,. They all depend upon the principle that the incorporation of the bacteria with the food to be given the larval bees will start the disease afresh.

Some of the more common ways in which this is done are the following:

1. The "swarming out" of bees from a diseased hive and coalescing with a healthy colony.
2. The artificial uniting of a mass of bees from a diseased colony with a healthy colony.
3. The giving of a comb from a diseased colony or even a very small piece of such diseased comb to a healthy colony.
4. The robbing of a diseased colony by bees from a healthy colony.
5. The feeding of honey taken from diseased colonies to healthy bees.

When it is known that the disease is caused by bacteria it would be readily granted that it would be contracted from comb containing diseased larvæ, but it may be questioned, as it has been, whether it could be contracted from honey taken from the combs of a diseased colony; but when it is considered that the bees are continually traveling back and forth over open cells containing the putrid remains of the diseased larvæ to the open cells of the honey and that they endeavor to remove from the cells the glue like mass with their tongues and then insert their tongues into the cells of honey to obtain their food, it must be admitted that it would be very strange if the honey were not thoroughly contaminated; and that it is so, and that the life of the germs is preserved in the honey, seems abundantly shown by an experiment I made with thirty colonies to which I fed honey, not to exceed one per cent of which was taken from diseased colonies. The result was that within two weeks twenty-nine of the thirty colonies were badly diseased.

Honey may be safely considered the great source of danger because under all possible circumstances it is greedily taken by the bees and conveyed to their hives and their own stores thereby contaminated. It is to the last degree important, therefore, that whenever the disease is known

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to exist, or its existence suspected, extreme care be taken that the bees have no opportunity to get a taste of contaminated or suspected honey.

Now as to the signs by which the presence of the disease may be certainly known.

So far as I have been able to discover there is one symptom and one only by which the average bee-keeper may determine without danger of error whether the disease is present, and that is found in the character of the remains of the larvæ before, in the course of time, they become dried up.

Brood dies from several causes, perhaps from other diseases, but there is always a plain distinction to be observed between the appearance of the larvæ dead from foul brood and of that dead from other causes. The substance of the former (foul brood) is homogeneous throughout, that is, all parts of the mass in a given cell are of the same consistency, that of the latter generally varies in consistency, one part being watery, another more or less solid; the former is of a solid color, brownish like coffee prepared for drinking by the addition of milk, the latter is usually of different colors, often partly white and partly black but if in the grub stage it is nearly white; the former is without form like a drop of glue, or becomes so on being touched, the latter in all cases retains its shape with more or less persistency; and lastly, the former is always viscid, the latter never. This characteristic alone, I believe, always furnishes a sure test. Take a sliver, match, or straw and inserting one end into the dead matter in a cell withdraw it, if the matter proves to be sticky or ropy as shown by following out the straw in a string you have foul brood, otherwise not. So far as is now known if the above rules are carefully applied there never need be any doubt as to whether the disease exists or not.

However, unless one's attention is especially directed to the matter, one is not likely to discover the presence of the disease until it has practically destroyed the colony and perhaps also been conveyed to other colonies, hence it is imporant as an assistance in the discovery of the disease to bear in mind the following facts:

The life of the larva may be destroyed either before its cell is capped or after, and in the former case it is not capped at all.

As soon as the larva is dead, perhaps before, it loses its naural glistening pearly whiteness.

The cappings of cells containing the dead larvæ have an unnatural appearance, they are generally more or less sunken, sometimes perforated, and often darker in appearance than is natural.

By fall, if the colony is still strong, such cappings are all or nearly all removed.

After some time, at least by late fall, the dead larvæ becomes dried down to a thin dark brown scale attached to the lower side and extending almost to the entrance of the cell. They are then almost imperceptible except to the experienced eye when held in a favorable light.

When the disease has made considerable progress it is attended by an extremely unpleasant odor which may be perceived by holding the nose to the comb affected; sometimes it may be felt even when the cover is raised in opening the hive.

After the disease has obtained a firm foothold the strength of the colony gradually declines and a suspicious and increasing listlessness is shown in its efforts to collect pollen and nectar, until, at length, unless the apiarist interferes, it becomes the prey of robber bees and the disease is widely disseminated.

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The time required for the destruction of a colony varies from one to three or more years, owing to the amount of infection and to the virulence of the disease in the particular case.

The disease seems gradually to wear itself out, if I may use that expression. Seven years ago in some cases in three weeks from infection nearly one-half the brood was dead. During the past season, in two colonies which each showed several cells in May, not a single cell could be found in September.

So far I have set forth the signs by which the disease is known, almost in mere outline indeed, but sufficiently, I think, so that any intelligent person using care and attention cannot go astray; and now it remains only in the same brief way to explain the methods which have been discovered by which the disease may be banished from the apiary, but first let me warn every one, except as an experiment, and at his own risk, not to place any reliance for a cure upon any of the drugs which have been recommended for the purpose. I have tried phenol or carbolic acid and salycilic acid in numerous cases, but in no single instance did it appear that even the first step was made toward effecting a cure.

There is a heroic method recommended by some and that is the destruction of hive, comb and bees by fire. I have never tried it, but no doubt it would be effectual so far as the individual hive is concerned, but whether it would be as to healthy neighboring hives would depend on whether it were properly done, and whether it were properly done or not would depend on whether any of the bees were allowed to escape—if they were the disease would probably be spread rather than circumscribed. The process is evidently one requiring extreme care, and only to be recommended to one who is sure of his plans.

In the method which I recommend and which I have thoroughly tested in a hundred cases or more without a single failure so far as I know, one must be prepared to disinfect the hive and all its belongings, except of course the bees, by a thorough boiling. My rule is to boil each part fifteen minutes. The combs are of course destroyed, but the wax is saved.

Having provided as many hives as there are colonies to be operated on—the hives to be furnished with frames either filled with foundation or with starters of foundation, combs will not do at all—proceed as follows:

Select a time when some nectar is being gathered and an hour of the day when the bees are not flying, then move the first colony a little to one side and place the new hive, which should be like the old in outward appearence as nearly as possible, upon the spot where the other stood; then as rapidly as possible take the combs from the colony and shake or brush all the bees upon the ground in front of the new hive, of which they will at once take possession, and then remove the combs and hive to a place of safety to be disinfected, being careful not to break the comb so as to let any honey get upon the ground or elsewhere for other bees to gather up. In like manner treat the other colonies, but if any of the combs contain brood which it is desirable to save they may be given to one or more of the infected colonies which are then to be removed for treatment as soon as the brood is hatched. This course will insure a cure.

If the bees were given a hive containing comb they would be sure to carry the disease with them.

During the past season I treated two colonies as an experiment when there were no flowers from which to gather nectar, and by carefully feeding them for two weeks, just sufficient to keep them from starving, they were

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afterwards found to be free from disease, but this course requires great care, or at least is not to be recommended without further experiment. In all cases it is desirable to place queen trap at the entrance of the new hive to prevent the bees absconding.

FOUNDATION FOR SECTIONS—COMPARISON OF DIFFERENT KINDS.

Ever since I first began to use it extensively, now fifteen years ago, comb foundation has been to me a matter of much interest and thought.

I have often noticed that much interest is taken in the best methods of extracting the wax from old combs, and in machines that will make the thinnest foundation but that little care has been exercised with regard to the best methods of manipulating wax to be used in making foundation so as to secure the readiest acceptance and the most thorough manipulation on the part of the bees and that to the interrogatory: Does the thinness of foundation bear any relation to the thinness of the septum of the comb made from it? I have heard hardly an inquiring answer; nevertheless I have all along felt a great interest on these points which experiments conducted in a small way had served greatly to increase, so it was but natural that when I found myself in a position where I could afford to do it somewhat extensively I became interested in the formation of plans calculated to bring out if possible the truth on these and kindred points.

The plan adopted was to procure a conveniently large variety of foundations made for use in sections by procuring from several makers samples of each kind made and comparing them by putting them into cases alternately with no separators and giving them as thus arranged to the bees to work out and fill. It was thought that results might be obtained in two ways:

First, it seemed reasonable to suppose that those sorts that were most acceptable to the bees would be drawn out first and most rapidly and consequently when capped would contain the most honey and that the preference of the bees could easily be detected by weighing the finished sections; secondly, by measuring the thickness of the bases of the cells of the comb produced it seemed clear that if any sort were to any considerable extent better adapted to its purpose than the others that fact would be clearly revealed.

For the purposes of the latter case I have so far been unable to see that the plan pursued could have been improved, but in the former case there is some degree of disappointment from the fact that it gradually became evident that the plan pursued was defective so far as the purpose sought was concerned in at least two particulars, viz., in attempting to compare too many kinds at once in one and the same case, for it is evident if three sections containing foundation equally good were placed side by side and the trio was flanked on either side by sections with inferior foundation, and the two exterior ones of the trio would derive an advantage on the side of the inferior ones which the central one containing equally good foundation would be deprived of, and then sections of the usual width, seven to the foot, were employed in the experiment which it became evident in the progress of the experiment were too wide to yield to the full the natural effect of differences in the foundation, for I saw in several cases that the bees worked out some kinds of foundation sooner and more rapidly than others at first, but when these reached about the thickness required for brood they were delayed to some extent and more force was put on the

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kinds that lagged to bring them up, so that in this way the results sought which would perhaps be abundantly revealed by the use of thinner sections were to a large extent concealed.

The remedy which should be applied in further experiments of this character seems to me to be evident; each sort of foundation which it is deemed desirable to compare with others should be compared with each of them separately and the sections should be so thin that the usual thickness of comb desired by the bees would a little more than fill the section's proportionate amount of space.

I have been asked whether in publishing the results of these experiments I should give the names of the manufacturers of the different foundations used. The object of the experiments is to obtain for the use of bee-keepers generally as much new and valuable knowledge with regard to their tools and business as possible, and it is evident that in the particular experiments of which I now write the value of the results depends almost entirely upon a knowledge of the names of the makers of the several varieties of foundation used, and I believe I should be doing injustice to any maker of foundation to suppose that he desired his name withheld, for are we not bound to believe that each one desires and is endeavoring to make foundation that shall yield the greatest possible profit to the user and that if he fails in any respect he desires to know it that he may apply the remedy? So I think I cannot do otherwise than give all the knowledge I possess in the matter. Not that I think there is anything so far that can very injuriously affect any manufacturer, but I hope there is what may prove an entering wedge to make a way of escape from the domain of theory and an entrance to the domain of fact in this matter of foundation, and lead to an effort to make it to please the mandibles of the bee instead of the eye of the purchaser. There may be something to learn yet about the manipulation of wax as well as about the peculiarities of foundation machines.

In the experiments now under consideration eight varieties of foundation were employed of which the sources and other distinguishing peculiarities are sufficiently indicated in the following table:

A. Dadant's Thin, sheets 12x4 inches, 15 to ½ pound—10 feet to the pound.
B. Dadant's Extra Thin, sheets 12x4 inches, 18 to ½ pound—12 feet to the pound.
C. Van Deusen's Flat-bottom (procured of A. L. Root), sheets 16½x3¾ inches, 16 to ½ pound—13.75 feet to the pound.
D. Root's Thin, sheets 16½x3¾ inches, 12 to ½ pound—10.31 feet to the pound.
E. Root's Extra Thin, sheets 16½x3¾ inches, 14 to ½ pound—12.03 feet to the pound.
F. Foundation made on Given Press, sheets 15x3 13-16 inches, 12¾ to ½ pound—10.09 feet to the pound.
G. Foundation made on given press, sheets 15x3 13-16 inches, 12 to ½ pound—9.37 feet to the pound.
H. Foundation, three years old, made on Given Press, about 9 feet to the pound.

Each variety of the foundation was designated by a letter of the alphabet as indicated and the letters were used for marking the sections to indicate the sort of foundation each contained and also as labels to distinguish the septa of combs made from the foundation when they (the septa) were cut out and sent away for the measurements hereinafter explained.

The foundation was cut to the same size, 3⅞x3¾ inches, and after being fastened in sections were placed in Heddon cases alternately as already stated so that each kind appeared seven times in each pair of cases. In all, eight cases were thus prepared but misfortune attended them in other ways

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than indicated in the foregoing; some were not well filled, two contained more bee-bread than I ever found I think in any other two cases and there was only one pair that was filled to my entire satisfaction, so that the material that could be fairly used for comparison by weighing was comparatively meagre and consisted of five of each sort from the two cases that were well filled, four of each from two other cases, and three of each from still another pair. The cases were selected with a view to their giving an opportunity of selecting well filled sections of each sort from the same relative positions in the cases and the sections compared were so selected. The following figures give the results in pounds and ounces:

	A	B	C	D	E	F	G	H
5 each sort	4-13.5	4-11.5	4-13.5	5	4-15	4-15.5	4-14.5	4-15
4 " "	3-13.5	3-13.5	3-13.5	3-15	3-15	4	3-15.5	3-15.5
3 " "	2-14	2-14.5	2-14.5	2-15.5	2-15	3-00.5	2-15.5	2-15.5
Total	11-9	11- 6.5	11-11.5	11-14.5	11-13	12	11-13.5	11-14

This indicates pretty clearly what I have been aiming at as well as the course with the modifications already suggested, which I think should be pursued in making further investigations in this line. Of course it would be rash to claim any very definite result from the experiment so far, but the totals here given will be found very interesting matter for comparison with the weights and measurements given further on which were procured with the expectation of evolving something that would assist in the solution of the general problem under consideration.

I suppose it would not be denied by any one that so far as the amount of wax contained in comb honey is concerned, we must take the amount of wax contained in natural comb, when used as the receptacle of honey, as the standard of perfection. How near does comb produced from foundation prepared for use in sections approach that standrad? And do combs produced from all sorts of such foundation approach equally near to that standard? It was with the purpose of making a beginning if possible at answering these and similar questions that I undertook the experiment with section foundation. It first occurred to me that samples of honey made from different kinds of foundation and from natural comb might be submitted separately to several careful individuals experienced in the production of honey for comparative tests, with the hope that the reports of such tests would give the light sought. With further thought that hope gradually grew dimmer, until the committee of the N. A. B. K. convention, to whom the septa cut from comb made from the several foundations were submitted for comparison, with a view to a report, gave the matter up in despair, when it went out altogether.

My next resource was mechanical instruments for fine work in measuring and weighing. I knew there were such instruments at our agricultural college, and in speaking of the matter with Mr. E. R. Root he informed me that his house possessed a micrometer, and generously put it at my service. To the septa of the foundations, I added one from natural comb, which I designated by the letter "I." I at once gave Mr. Root a set, and measurements of them were taken by C. C. Washburn of his establishment, who is skilled in such work. These measurements appear further on.

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To procure samples of comb for the purpose of the weighing test, I took two sets of sections of the several varieties and extracted the honey as thoroughly as possible; then after filling the cells with water I plunged them in a large vessel of water, where they remained twenty-four hours, when they were further washed and then thoroughly dried. To get pieces of exactly the same size, I first shaved off the comb from both sides to bring all to an equal thickness, about one-half inch. To accomplish this I began by cutting away the section box within a little less than a fourth of an inch of the septum, making the opposite sides perfectly straight and parallel; then, using these sides as guides, with a long straight sharp knife all portions of the comb jutting out were shaved off, leaving a perfectly flat surface of comb. As guides for shaving off the other side, two straight pieces of wood of even thickness, about half an inch, were nailed to a smooth, flat board, and after cutting away the other edges of the section box sufficiently, it was laid on the flat side of the comb between these and fixed firmly with wedges, when the superfluous comb was shaved away as before. After this process was completed, a circular piece to be used for the purpose of the experiment was cut from each with a rim of tin a little more than two and a half inches in diameter, used after the manner of a cake-cutter, thus leaving in each case the septum with a portion of the cells upon each side. The first set I thus prepared came short of perfection to such an extent as to be unsatisfactory, so I made use of the other set only. These were taken to the college, and after having them weighed I cut each sample in two, giving one part to Dr. Beal of the college for measurement, reserving the others and afterwards sending them to Mr. E. R. Root to secure another set of measurements from Mr. Washburn so as to get them from two capable persons of the same comb as nearly as practicable. As it turned out, Mr. Washburn was ill when these reached him and a substitute was found in Mr. Hubbel. As will appear in the summary he took a varying number of measurements of the samples—from once to five times—while in the other cases these measurements were taken in each instance.

The weighing was done by Mr. Frank S. Kedzie, adjunct Professor of Chemistry, with the following results in grams:

	A	B	C	D	E	F	G	H	I
Weight in grams	1.93	2.2393	2.093	2.2349	1.9664	1.8482	1.8886	2.083	1.6821

If any one has a curiosity to turn the results into grains he can do so by multiplying by 15.432, the number of grains in a gram.

The measurements of the thickness of the bases of the cells now follow in their order in ten thousandths of an inch.

WASHBURN'S MEASUREMENTS.

	A	B	C	D	E	F	G	H	I
	95	86	85	76	86	96	78	66	57
	95	90	88	110	105	70	75	90	57
	125	85	93	96	92	75	75	82	57
Total	315	261	261	282	283	241	223	238	171
Average	105	87	87	94	94	80	74	79	57

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DR. BEAL'S MEASUREMENTS.

	A	B	C	D	E	F	G	H	I
	70	110	65	120	70	60	60	80	50
	100	65	70	100	100	60	60	60	50
	80	100	70	80	90	80	60	60	50
Total	250	275	205	300	260	200	180	200	150
Average	83	92	68	100	87	67	60	67	50

MR. HUBBELL'S MEASUREMENTS.

	A	B	C	D	E	F	G	H	I
	95	80	62.5	75	70	62.5	50	65	50
		110	67.5				90	75	75
		90							
		95							
		70							
Total	.....	445	130	.....	.....	.....	140	140	125
Average	95	89	65	75	70	62.5	70	70	62.5

THE GENERAL AVERAGE.

	A	B	C	D	E	F	G	H	I
Washburn's average	105	87	87	94	94	80	74	79	57
Beal's average	83	92	68	100	87	67	60	67	50
Hubbell's average	95	89	65	75	70	62.5	70	70	62.5
Total	283	268	220	269	251	209.5	204	216	169.5
Average	94	89	73.3	89.6	83.8	69.8	68	72	56.5

All this work it seems to me has been very satisfactory, for while there has not been particular uniformity—a thing which could not be expected—there has been general uniformity.

I must close this article, already too long, by mentioning some of the apparently tenable inferences which may be drawn from these tests:

1. No comb made from foundation quite equals in fineness the natural, though in some cases it approaches it very closely.

2. In foundations of the same make the thinner has but very slight advantage over the heavier in point of producing comb of lighter weight.

3. That foundation kept for a long time before using has but a slight disadvantage if any as compared with that freshly made. The slightly greater thickness of the septum of comb made from "H," as compared with that made from "G," may well be accounted for by the fact that "H" was heavier than "G."

4. Granting that different methods ordinarily in use of manipulating wax do not make a difference in the character of foundation made from

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such wax, that foundation made on the Given press has a pretty decided advantage over that made on the roller machines.

If these investigations lead manufacturers of foundation to strive to learn the best methods of manufacturing wax and to find out what peculiarities characterize the best foundation machines they will not have been made in vain.

CERTAIN PREPARATIONS FOR WINTER.

Some of the preparations for winter are so important to the bee-keeper that I venture to append some well tested directions, touching points that are frequently, not to say generally, neglected.

If other work of the apiary, such as the uniting of colonies and due oversight with regard to queens has been timely attended to, there is little to require the attention of the apiarist during the first twenty days of September except the crop of fall honey in places where there is such a crop. For the securing of this the bees must have sufficient room and at the close of the flow all surplus receptacles should be promptly removed and the honey stored in a warm, dry room.

The clearing of the supers of bees will be found a much more difficult undertaking in the fall than it was in July. The bees are sluggish and stubborn and respond very slowly even to deluge of smoke, so that the apiarist may well try coaxing in place of driving and make use of bee escapes. No doubt they will work more slowly than in the summer but they will still be found a great luxury.

The extracting of the honey from combs destined to that end, if stored in a proper place, should not be very long delayed, else the operation will be found slow and vexatious by reason of the thickening of the honey through evaporation.

When there has been a yield of fall honey but little if any feeding for winter stores will be found necessary even though the brood chambers be quite small, for at that season the brood nest is much contracted thus giving abundant room for stores, but each colony should be examined, for some of the best colonies, if the bees have much blood of the German race and the brood chambers are small, may have put almost all their honey into the supers and when found short of stores the want must be supplied without delay.

This examination does not imply the opening of hives and the handling of combs. This should never be done. It is a course both unpleasant and injurious. Get at the weight of your hive, supposing it to be supplied with empty combs only, by weighing a few of this description, then add to the average weight thus found twenty-five or thirty pounds for honey and bees which will give the weight which each hive must have to be safe for winter so far as the amount of stores is concerned. Now take the scales into the yard and weigh a few colonies, marking the weight in each case in a convenient place on the proper hive. When a colony is found whose weight just about reaches the limit, replace the colony and then bend over and "heft" it. Do this repeatedly and study the weight. Now if but few of the colonies need feeding most of them go so much above the limit that it will be perceived at once on hefting them though it may be necessary to return to the "pattern" occasionally for comparison.

In this way the great majority may be quickly disposed of as being clearly safe. The doubtful and the light ones must then be weighed and marked.

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The syrup to be fed may be prepared by bringing to a boil any given number of pounds of soft water and then adding by pouring in gently, twice the number of pounds of the best granulated sugar. When this is again brought to a boil it is ready to be fed as soon as it becomes sufficiently cool.

The kind of feeder used is not important. The Heddon feeder is most convenient as enough can always be fed at once and the bees are always safe from drowning, but a tin pan with a piece of cloth, with care, answers very well, or any of the smaller feeders will do if filled so promptly that the bees will get what they need about as quickly as they can take it.

All this should be attended to at once on the cessation of the storing of surplus and where the fall crop is wanting, the 20th of September should see that work begun, and in all cases the work should be finished early in October. In localities where there is no nectar to gather after basswood fails, the amount of brood reared during August and September is likely to be exceedingly limited and I should greatly fear for the safety of colonies entering the winter with so large a proportion of aged bees as such conditions would entail. Under such circumstances, if I wished to make their wintering well as certain as possible, I should take pains by proper feeding to increase the amount of brood as much as possible during the first half of September.

This work of proper preparation for winter is to the apiarist, if much feeding is to be done, the most trying duty of the year, and happy will he be who can look back on it promptly and properly done.

SOME EXPERIMENTS IN WINTERING.

During last fall and winter I made such efforts as I could under existing circumstances to get some light on the problems growing out of the matter of wintering bees. My bee cellar is under my honey house and is fifteen by thirty feet with a cistern in one end. I have wintered bees in this cellar for seven or eight years with almost uniformly excellent success and yet it now seems certain, from my experiments with a hygrometer, to be a very damp one, there being a difference, at a temperature of from 45 degrees to 50 degrees, between the wet bulb and the dry bulb, of only one-half a degree, which indicates that the percentage of moisture is about 96—almost complete saturation.

It is claimed by many prominent bee-keepers that moisture is one of the principle causes, if not the principal cause, of the winter disease of bees known as dysentery, but if this were true I should have expected to find it prevailing largely among my bees during the last winter, but such did not prove to be the case. In fact, though I suffered a larger percentage of loss than I ever did before in this cellar—about 20 per cent—yet only a small proportion of those that perished showed even a little evidence of that disorder. I discovered only two cases that could be called really bad, in one of which the colony died and in the other the colony had regained its health and was in good order and of good strength when removed from the cellar, and still remains so. This case was a peculiar one. The hive was an eight-frame L hive and the bottom board was left on in the wintering. Such a forbidding receptacle for bees as this was when taken from the cellar about the 10th of April, I have seldom seen. The bottom board was covered with a mass of sticky ordure to such an extent that only now and then would a bee venture upon it to

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gain the outside of the hive. The cover was well sealed on and when pried off it ran with the almost incredible amount of water and the honey board and combs outside the cluster were wet and white with mould. When the bottom board was removed and a clean one subtsituted, the bees came out to fly as clean, healthy and strong as one would care to see.

I cannot reconcile this case, as well as many others I have examined recently, with the theory that moisture is the cause of dysentery. Yet I think I have good evidence that moisture under certain circumstances is harmful. When the strength of the colony is sufficient to enable it to keep its immediate neighborhood dry, it appears not to suffer from moisture, but if it is so deficient in numbers and vigor, one or both, that it is unable to do that, it seems reasonable to suppose that it must perish, being either chilled to death in the cluster or else driven to desperation by the misery of the situation, scattering and leaving the hive tenantless. The slight spotting of the combs which often occurs under such circumstances should not, I think, be taken as a sign of the trouble known as dysentery. It is rather the result of the weakness of approaching dissolution than the cause of it.

Last season, after the failure of clover and basswood there was very little nectar to be gathered in this locality either during the remainder of the summer or during the fall, from which fact it resulted that at the beginning of winter a large portion of the colonies were not only weak in bees but especially so in young bees. It was not difficult to foresee the probable consequence of this state of things, so I was not surprised at the loss I have incurred. Apparently the old bees died off during the early part of the winter, for more than the usual number left the hives during that time, thus reducing the cluster to a size too small to enable it to successfully combat the unfriendly influences of moisture combined with a cellar temperature. Perhaps in many cases a cellar temperature alone would prove sufficient to create such a feeling of discomfort as to make the bees restless and so cause them one by one to leave the cluster and wander out of the hive and be lost, but I have no doubt that in other cases the added influence of moisture was necessary to accomplish total ruin. That the decline of these colonies came about in the way I have indicated seems us substantiated by the fact that in almost all these cases very few dead bees were left in the hives and in only now and then one had the bees last to perish preserved the form of a cluster to the last.

Quite a strong effort was made to determine if possible whether sealed covers were, in cellar wintering a disadvantage, and a large number of hives with such covers as well as of those with loose covers were set apart and carefully examined with the result that where the colonies were of fairly normal strength there was no apparent difference—almost every one of that class wintering very satisfactorily. About the only advantage of the loose covers was that the combs were preserved dry and clean. It was also observed that the entire removal of the bottom board, leaving the bottom of the hive entirely open, served largely the same purpose as a loose cover though not to quite the same extent. In some of the larger hives having a bottom board as well as sealed covers, the combs outside the cluster were very wet and mouldy. In the case of the weaker colonies sealed covers were comparatively detrimental. Of course all this is in a cellar where the temperature was maintained during the entire winter at 45 degrees and over, and it can readily be believed that the class of colonies that would fail to cope with the conditions induced by sealed covers out of doors

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would be very considerably enlarged; not, I think, because the moisture would induce the disease known as dysentery but because it would require stronger colonies to ward off the encroaching chilliness caused by constant excessive evaporation so that the health and vigor of a larger number would be undermined and finally destroyed.

Of course so far it does not appear that sealed covers have any advantage in any case but inasmuch as they cause wet and mouldy combs it would be well worth the while to loosen all covers when the bees are put into the cellar and certainly so unless the bottom boards are entirely removed.

The losses I have incurred speak plainly of the importance of giving strict heed to the old rule: Keep all colonies strong. By doubling up about one-third of my colonies in September I should have escaped with practically no loss.

SUGAR FOR WINTER STORES.

With a view to bring out in some measure if possible the difference in value between sugar syrup and honey for winter stores, I selected at the proper time in the fall of 1893, twenty-four colonies, one-half of which were to be fed sugar syrup for winter stores and the other half to be supplied with honey for the same purpose. Considerable care was taken to select and arrange the colonies so as to have the two sets as nearly equal as possible in point of strength, but the bees were not weighed separately from the hive, the strength being estimated by the amount of space occupied by the cluster. This is not a satisfactory course to pursue when it can be avoided. I now appreciate the importance of the weighing better than I did at the time the experiment was undertaken, and that course will be taken if the experiment is repeated. At some seasons of the year the manipulation necessary to secure the separate weight of the bees would be so objectionable as to preclude its use, but at the time contemplated it would be neither objectionable nor very difficult. Owing to the character of the latter part of last season, few of my colonies were very strong last fall, and in the effort to select colonies with such conditions as would facilitate the operations of the experiment it turned out that those selected were considerably below even the average strength, and in this way another mistake was made which should not be repeated. It is necessary to point out further that the colonies selected were partly in two story Heddon hives and partly in one story ones, and that in order to deprive one set almost completely of honey and to supply the other set with an abundance of honey for winter stores it was found necessary to so manipulate the hives that those to be wintered on honey had two story hives and those to be fed sugar syrup one story.

These arrangements were made the last of September and the necessary feeding was done at once.

The hives were first weighed when they were put into the cellar, the 15th of November, and again when taken out the first days of April. It will be observed that two are wanting from the sugar fed set and three from those wintered on honey, but as none of them, so far as appeared, perished on account of dysentery or on account of any peculiarity of either kind of stores, nothing can be predicated on that fact for or against either kind of food.

The following figures show the weight of each hive at each season and the difference or amount consumed by each in pounds and ounces:

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The set with sugar stores.			The set with honey stores.		
Fall weight.	Spring weight.	Amount consumed.	Fall weight.	Spring weight.	Amount consumed.
33-12	29-4	4-8	54-4	48-8	5-12
31	28-8	2-8	57-8	51-12	5-12
30	26	4	56-4	45-8	10-12
33-4	30-8	2-12	63-8	54-12	8-12
29	26-4	2-12	45-4	39-8	5-12
29-8	26-8	3	47-8	40	7-8
32-4	29	3-4	48-4	43-12	4-8
32-4	29-8	2-12	46-8	41-4	5-4
26-12	23-4	3-8	70-12	63	7-12
26-8	24-4	2-4			
		31-4			61-12

The amount of stores here shown to have been consumed during the winter is, I think, remarkably small, at least it is smaller than anything I have hitherto become acquainted with and this proportion seemed to hold throughout my apiary. Indeed, in most cases examined, the stores seemed scarcely touched and though I lost a considerable percentage not a colony perished of starvation. But the important point brought out by this experiment is the economy of feeding sugar syrup for winter stores instead of honey where feeding is necessary. From an examination of the figures we find that the average consumption of sugar stores was but $3\frac{1}{8}$ lbs. while that of honey was $6\frac{7}{8}$ lbs. nearly, or more than twice as much. This has added importance when we remember what has been well established that granulated sugar syrup is fully equal to the best honey as winter food for bees and far safer for that purpose than any inferior honey.

AN EXPERIMENT IN OUT OF DOOR WINTERING.

With a hope of learning something bearing on the subject of out of door wintering I made the following experiment: In November, at the time when I was putting the bees into the cellar for the winter, I selected six colonies of good average strength each, in a single story Heddon hive, then the hives were placed one above the other with nothing between them except a single sheet of wire cloth so prepared that each colony was provided with its proper entrance. Of course the lower hive retained its bottom board and the upper one its cover, but the rest of the covers and bottom boards were entirely removed. The lower hive was raised about ten inches from the ground, then the whole was well packed below, and with about four inches of dry planer shavings on top and on all sides except about four inches in width of the front left for the entrances.

The cover was left sufficiently loose to allow the escape of moisture into the packing, and the entrances were closed to within about an inch in width. During the winter these bees had comparatively frequent flights and seemed to be doing well. About the 20th of March some of the upper ones brought in considerable pollen, but the two lower ones exhibited but little signs of life. Then came a blizzard the last of March and first of April and when that had passed and other colonies began to bring in pollen these remained ominously silent; indeed the silence seemed chronic and an examination revealed that it really was so, they had all

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passed away. The combs were dry and clean and the stores abundant, but there were no live bees and very few dead ones. There was very little if any appearance that any had finally perished in a cluster. Unless the arrangement of the hives and the thoroughness of the packing had deluded the bees into thinking that it was so warm that they might with safety try the open air and thus untimely perished. I know not how to account for their utter destruction.

Though the stores of five of the six colonies was largely sugar syrup, the six colonies consumed an average of five pounds and thirteen ounces over and above the weight of the bees which had perished outside.

R. L. TAYLOR.

Lapeer, June 1, 1894.

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MILLET.

BY A. A. CROZIER, ASSISTANT.

Special Bulletin No. 2.—Farm Department.

"What shall we sow when Clover fails?"

The recent failures of the clover crop in central Michigan, due chiefly to the ravages of the imported clover root borer (*Hylastes obscurus*), and the apparently increasing difficulty of obtaining a good seeding of the ordinary grasses and clovers, owing to dry weather, have created an unusual demand for some plant which can be employed instead to furnish at least a temporary supply of fodder. Indian corn serves admirably for that purpose, and is deservedly coming to be better appreciated and more largely grown for its fodder as well as its grain. But there are times when corn cannot be used, as when labor is scarce, the land is rough, or the season too far advanced for planting corn. Under such circumstances millet has long been a favorite crop.

SOIL FOR MILLET.

The millets thrive best on a warm, open, fertile soil. They are gross feeders and are well adapted to new land, where fertility is abundant and the soil loose and porous. On old land it is important for this crop that the soil be well prepared, particularly if it is heavy; but under nearly all circumstances sandy land, unless very poor, gives the best results.

TIME TO SOW.

Millet grows best in the hottest weather, and should not be sown until the ground has become thoroughly warm, generally about the first of June. It is time enough to sow millet after corn is planted. It will then come on rapidly and get the start of the weeds. For the large German Millet, the sowing should not be delayed much after that time, as that variety requires the entire season in this latitude. The smaller variety, known as Common Millet, may safely be sown as late as the first week in July, and in seasons not too dry it will produce a good crop when sown on land from which hay or wheat has been harvested. Where practicable, however, all the varieties should be sown early in June in order to escape, as far as possible, the influence of the late summer drouths.

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AMOUNT TO SOW PER ACRE.

This should vary with the variety, condition and character of the soil, the climate, and the purpose for which the millet is sown, whether for hay or for seed.

In seeding for hay, if too little is used the fodder will be coarse and unpalatable. If too much seed is used the crop will be small and fail to mature. A moist, fertile soil will bear heavier seeding than a poor, dry one. If seed instead of fodder is wanted, less seed should be sown. For that purpose, especially where the soil is poor or weedy, better results are obtained by sowing the crop in drills and cultivating it.

The amount recommended to be sown per acre varies from one peck to one bushel, and both these limits are sometimes exceeded. Three pecks per acre was the standard adopted the past season in seeding for hay at this station, but as the season was very dry the amount proved to be too large, and our yields would undoubtedly, in most cases, have been greater if we had used less seed. I think half a bushel per acre sufficient, in most cases, if sown for hay, and one peck if sown broadcast for seed.

EFFECT ON THE SOIL.

Millet is generally regarded as being an exhaustive crop, and not without reason. It draws largely on the available fertility of the soil and its small surface-feeding roots give back but little in return. Still this is not always an objection. On new timber land, or on rich prairie soil, a crop like this to take the "fire" out of the soil is often an advantage, particularly if grain crops are to follow. W. M. Hays of the Minnesota experiment station says: "Wheat seems to do as well after millet as on a summer fallow." In Nebraska millet is said to put the land in excellent condition for sugar beets.

AS A CLEANING CROP.

Millet is often used for this purpose, on account of its strong, rapid growth. If a low, wet spot is to be reclaimed it can be plowed in June, when too late to plant corn, and sowed to millet, which will kill out most of the wild growth and leave the land in the fall in good condition for timothy or some of the other permanent grasses.

As a general crop for subduing weeds it has some advantages over buckwheat. Its seeds do not usually remain in the soil as do those of the buckwheat, and become a weed in after years. It also stands drouth better than buckwheat, and is therefore better in dry seasons, though under favorable circumstances buckwheat will grow up and produce a heavy shade somewhat quicker. Even when the millet fails to produce a sufficient growth to overshadow the weeds and choke them out it draws so strongly upon the soil moisture that they have little chance to grow.

A writer in the *Country Gentleman* states that he completely rid a seventy-five acre lot of Canada thistles by sowing Hungarian Grass and following with Giant Clover. Hungarian was sown at this station this season upon half an acre of Canada thistles and one-fourth acre of Quack grass. Neither was entirely killed by the millet, but better results were obtained than on two similar patches of these weeds sown to buckwheat.

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CURING MILLET HAY.

There is an impression that millet hay is particularly difficult to cure. So far as this is true, it seems to be due solely to the heavy growth which it makes under favorable circumstances and to its rather large, fleshy stems. The treatment required to make good millet hay is in no way different from that required in making hay of any other kind, except that usually more of the curing should be done in the cock, since if the hay is left spread out until fit to be put in the mow, the leaves will often be overdried and the stems rendered by the exposure more hard and woody than they would otherwise be.

The difficulty in curing millet hay is largely due in many cases to the lateness of the season at which it is performed, for if millet is sown late, as it often is, it may not complete its growth until well into the autumn, when damp, rainy weather prevails. The best that can then be done is to cut it on a fair day, and when about two-thirds cured bunch the hay into small cocks to stand until ready for the barn. Sometimes millet can be put up in cocks the same day that it is cut, but often it will have to lie until the second or third day. Dew or rain upon it before it is fully cured seems to injure millet less than other grasses, certainly much less than clover. When well put up, millet hay sheds rain much better than that of most other grasses, and the cocks may stand in the field some time if necessary before being hauled. Millet hay settles down very solid and will weigh considerably more than the same bulk of other hay. This is evidently due to the fact that the stems of millet are solid and not hollow as in most meadow grasses.

MILLET AS A SOILING CROP.

Millet is often cut and fed green. It makes a quick growth and comes at a time when other green feed is apt to be scarce. On rich soils it produces a large crop, and it is better for sowing broadcast than corn. If fed to horses not accustomed to green feed it should be used with moderation, or undue salivation, and perhaps colic, may result. A succession of green fodder to supplement the ordinary grasses may be obtained by sowing rye early in September, to be cut off the succeeding May and followed by Hungarian. By the time this is gone, about the first of August, a crop of sweet corn may be ready for use.

Millet has been employed to a limited extent for ensilage with satisfactory results. A trial of millet for this purpose is now in progress at this station. Its yield per acre will not, however, usually equal that of Indian corn.

MILLET FOR PASTURE.

To meet the need of pasture during July and August, when the ordinary pastures fail from drouth, millet is sometimes sown. It answers fairly well for the purpose, though if pastured very closely it lasts but a short time, as it does not form a turf. The best variety for this purpose is probably Hungarian, although Common Millet appears to answer nearly as well. Both are better than the large German Millet for this purpose, as they tiller better and sprout more freely after being pastured down. An acre and a half of Hungarian and other millets formed part of the pasture for

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a flock of lambs at this station the past season and furnished good feed for three weeks, commencing the first of August. This piece was sown June 7, and was well headed out when the lambs were turned in. Millets, particularly Hungarian, also furnish some feed by the sprouting of the stubble after being cut for hay, especially if cut early. Stewart in his "Feeding Animals," says: "When millet reaches the height of eight inches sheep may be folded upon it and allowed to crop off four or five inches, the hurdles being moved each day to prevent it being eaten too close. It will spring up anew, and more completely cover the ground than before. If care is taken it may then be folded over three or four times in a season."

SEEDING WITH MILLET.

Can millet be used as a crop with which to seed the land to grass or clover?

On June 12 four acres of new land were sown to Common Millet and one-half of it seeded to timothy, the remainder to clover and timothy mixed. A good rain followed and both the millet and the seeding came up well. The millet was cut Aug. 27, when the heads were beginning to turn yellow. The timothy had then apparently all died, but much of the clover could still be seen. After the fall rains came on a portion of the field which had been a swamp came up thickly to timothy from seed which had not previously started. Otherwise the seeding was not a success.

In some localities seeding with millet appears to give better results.

IS MILLET DANGEROUS TO FEED?

There is a prevalent opinion that millet is unsafe to feed, particularly to horses. There is some ground for this belief. Millet hay when fed in large quantities, particularly, if cut when nearly ripe, often causes in horses an excessive flow of urine which has a weakening and depressing influence upon them. No such effect has been observed on other kinds of stock. The awns, however, in millet that has become over-ripe, occasionally cause irritation and its seeds are seldom digested properly by any stock except sheep. In horses the undigested seeds in the stomach have been known to cause colic. If millet seed is fed to any animals besides sheep and fowls it should be ground. Millet straw after the seed is threshed is excellent fodder and has never been known to prove injurious. Ordinary millet hay, containing the more or less fully developed seed, should be fed with moderation and be alternated if possible with other fodder.

FEEDING VALUE OF MILLET.

Millet hay and grain have nearly the same composition as the corresponding parts of Indian corn, and are therefore of high nutritive value. Cut at the proper time and well cured millet is quite as readily eaten and more conveniently handled than corn fodder. It will not produce so large a yield per acre but has the advantage of requiring no cultivation and of being able to be harvested and stored like other hay. On account of its heavy and compact character and its large amount of seed a given bulk of millet hay will go farther than an equal amount of ordinary hay. Millet

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whether green or cured is especially valuable as a food for cows and is more largely used for that purpose than any other. For work horses additional grain is required, preferably oats.

VARIETIES OF MILLET.

Common. German. Hungarian.

There are three varieties in general cultivation in this State, and these appear to be better adapted in our climate to the ordinary purposes for which millet is grown than any of the newer sorts that have been tried. They are,

1. *Common Millet.*—This may be recognized by its green, nodding head, which is rather slender and tapering, and loose or open at the base. Its stems are small and generally grow several from each root. It is the earliest of our well known millets and in favorable seasons will ripen its seed if sown as late as the first of August. It makes excellent hay but will not yield as much as the later varieties. Its chief value is for sowing late. Its seed is so easily grown that it nearly always sells at a lower price than that of other millets.

2. *Hungarian Grass.*—This is recognized by its compact, nearly erect, purple heads and by the dark purple color of many of its seeds. It does not withstand drouth so well as Common Millet, but on rich soils in favorable seasons it will produce a larger yield. It is the favorite variety on most dairy farms in the eastern states.

3. *German Millet.*—This is a comparatively new sort, and though it has been generally known in this country only since about 1875, it has become the most popular variety in cultivation. It may be recognized by its coarse, upright stems, generally but one from each root, and its large, nodding head. The seeds are smaller than in either of the above varieties, generally round instead of oval as in those sorts, and frequently of a more or less golden color. The plants when they first appear above ground are more feeble than in either of the other varieties mentioned, and somewhat more

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care is therefore desirable in fitting the ground and in avoiding unfavorable soils or too early sowing. As the plants develop, however, they become almost as robust as sorghum or Indian corn. This variety is prized for the large amount of fodder which it produces, four tons per acre not being an unusual yield on good soils in a favorable season. It requires a long season to fully develop and in some years the seed does not all ripen in this state. If sown the first of June, however, on fertile sandy soil, not too subject to drouth, the seed may be expected to ripen in the southern half of Michigan about the first of September. Owing to the uncertainty of its ripening in northern latitudes, German Millet seed is apt to be high in price so that the seed of the inferior Common Millet is often substituted for that variety. First class German Millet seed may always be recognized by its being *round* and *small*. The best German Millet seed comes from the south, the seed grown in Tennessee being considered the standard of excellence in market. Northern grown seed will not give so large a crop, though it may ripen somewhat earlier.

SUMMARY.

Millet is used chiefly as a "catch crop" for hay, since it can be sown in spring whenever it is discovered that a seeding of the permanent grasses has failed, or that a hard winter or insects have destroyed the clover. It may be sown when too late to plant corn.

Millet requires good soil, preferably sand, and is especialy adapted to new land. Sow half a bushel per acre for hay, one peck if for seed.

Millet hay is usually cured by cocking it up when partially dry and allowing it to stand for several days before being hauled to the barn, as is often done with clover.

Millet hay is strong feed and should be used with caution, being alternated if practicable with other fodder, especially if fed to horses. It is safer and more palatable if cut before the seed begins to ripen.

The best variety is German Millet, providing the soil is good and it can have have the entire season. For late sowing, or poor soil, use Common Millet. Hungarian Grass, on fertile soils, in a moist season, will give a large yield of excellent fodder.

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Hungarian Grass. Common Millet.

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German Millet.

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PRESS BULLETINS.

These press bulletins are short articles on topics of much importance, and were sent to the leading county papers of the state, that the people might have such information at a time when most needed.

THE ARMY WORM.

The northern part of our state has suffered considerably this season from a raid on meadows and grain fields by the army worm. It came too late to do much harm to wheat, rye and barley; but oats, corn and timothy fed the armies wherever found. Potatoes were untouched, peas sown with oats were left while the oats were eaten, and clover in timothy was left. The true army worm seldom, if ever, touches the foliage of trees or shrubs. There are many invasions of insects known as the army worm, but this is the only real army worm, and is known scientifically as Leucania unipuncta. It may be recognized by the general dingy black color with the following longitudinal stripes: On the back is a broad dusky stripe with a narrow white line in the center; below this is a narrow black line, then follows, in the order named, a narrow white line, a yellowish stripe, a faint white line, a dusky stripe, a narrow white line, a yellowish stripe, and an obscure white line; the belly is a dirty green.

The army worms change but little in color through their entire growth. When fully grown they are about one and one-half inches long. They then bury themselves in the ground, when they finish feeding, and a few days later transform to a chrysalis, or pupa. They will remain in this condition until the last of August or first of September, when they will appear as a reddish brown moth, similar to the dingy moths flying around the lights at night. These moths do not feed on the plants, but mate; and a few days later the female will commence laying eggs on the grass in meadows, pastures and especially waste places, such as marshes and "cat holes." The moths soon die. The eggs remain over winter, and the next spring hatch out into small army worms that feed and grow just as their predecessors did.

The army worm caterpillars and moths may be found in limited numbers almost any season, but it is only an occasional season when they march

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out from their usual feeding ground, the marshes, and strip the surrounding fields of their growing crops. A dry season is very favorable for them to increase rapidly and soon to spread outside of the marshes on surrounding grass, when tender food becomes scarce. If people with marshes on or near their farms would take the trouble to burn the marshes over at any convenient time through the fall, they would burn most of the eggs, and so prevent what might result in an army worm invasion the next year.

There are a great many parasites, such as the "blow flies" and slender bee-like parasites that lay their eggs on the army worms. The egg hatches into a maggot that feeds on the army worm, destroys it, and later changes into a parasite like its parent.

When an army worm invasion occurs, the best thing that can be done is to trap the caterpillars in ditches. When they start from their breeding ground it is in some certain direction, and few obstructions stop them or change their course. If they come to a building, they climb up over it, down on the other side, and continue on their journey. If it is a brook, they bridge it with their numbers and pass on, or perish in the attempt. When they come to a ditch, they drop into it and attempt to climb up the other side, but if it is properly constructed, they will keep dropping back because of the loose soil near the top. When the ditch is well covered, kerosene may be poured along in it and ignited, or straw put in the ditch and burned. Another method is to plow or cut another ditch in front of the first ditch, and bury the ones in the first ditch, and so continue ditching ahead of them. When the army is once in a field, little can be done to stop their ravages, except by burning the field or rolling with a heavy roller.

G. C. DAVIS,
Entomologist.

PRICKLY LETTUCE.

HISTORY.

This plant is one of the most vigorous weeds that has ever appeared in our state. During the past few years it has spread from the Atlantic to the Pacific.

Soon after the close of the war of the rebellion this weed was introduced to this country from Europe and was first observed growing in waste places near Cambridge, Mass. Traveling rapidly westward it reached Ohio in 1878. In 1882 it was noticed in Detroit, reaching Owosso in 1887 and Grand Rapids the next year.

During the past six years this weed has spread throughout the whole state, and now from its strongholds in the waste places about our cities and villages it is invading farming communities.

Prickly lettuce is the wild parent of our cultivated lettuce and in its native land has never shown any of the vicious tendencies it is now exhibiting in the land of its adoption. Here it seems to want the earth, and it has evidently come to stay. From numerous inquiries lately received by the

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station in regard to this plant, it seems that possibly many people fear that this weed is the dreaded Russian thistle.

DESCRIPTION.

Prickly lettuce is an annual plant from two to five feet high with numerous slender branches towards the upper part of the stiff, solid stem which when broken or cut pours out a milky juice. The bluish green leaves have a row of prickles or bristles on the under side, along the mid-rib and by a twist near the base, assume a vertical position by which the plant may be easily recognized. Flowers are yellow in small heads generally appearing late in July, producing from twelve to twenty flat, brown-black, ridged seeds, having parachute-like attachments by which the wind is able to carry them a long distance.

REMEDY.

Cut the plants close to the ground early in July before the blossoms appear. New branches will immediately spring up from the cut stems so that repeated cuttings must be made later in the season.

It is not probable that this pest will ever prove troublesome in meadows or in well tilled fields, but in all waste places, especially in vacant lots in cities and villages, it will become a continually increasing nuisance unless speedily stamped out.

PREVENTION OF STINKING SMUT OF WHEAT.

The severe losses caused by this wheat disease in the past have led the experiment station to conduct a series of experiments directed towards the discovery of some means of prevention.

It is known that the disease is produced by the growth of a separate and distinct smut plant in the wheat plant itself and that the smut plant is propagated from year to year by its spores which adhere to the wheat kernels, making them dark and dingy and giving a sample of wheat a disagreeable and characteristic ordor when present in any noticeable quantity. Means of prevention are directed towards killing these spores without injuring the vitality of the seed wheat.

In the autumn of 1893 wheat badly affected with stinking smut was procured for seed, and small quantities subjected to different treatments were sown on adjacent plots. In all fifty-six different treatments were tried. One of them was so simple and at the same time proved so efficacious in entirely exterminating the smut without injuring the vitality of the seed wheat that it is here commended to the farmers for extended application to the seed wheat this fall.

The treatment consists in soaking the seed wheat affected with bunt, as stinking smut is called, in a saturated solution of lime for twenty-four hours, then sowing as soon thereafter as possible. The seed should be thoroughly cleaned through a fanning mill before treatment.

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To make the solution take ten pounds of unslaked lime for each barrel (32 gallons) of the solution needed; slake it, using just water enough to make a thick pasty mass when thoroughly slaked; add to this mass enough water to make the 32 gallons, which, when ready for use, will present a milky appearance.

Pour the wheat into this solution, keeping it thoroughly stirred meanwhile, and let stand for twenty-four hours.

On removal from the solution the wheat must be spread out thin to dry. The drying may be hastened by throwing on slaked lime and mixing. Care should be taken that the wheat is not allowed to heat at any time, especially when wet.

Sow at any time thereafter, using more seed to the acre than customary as the kernels of wheat will be swollen by the treatment.

The devices and utensils for treating the seed may be varied according to the amount of seed to be handled. When only a few bushels are needed, good water tight salt barrels, with a hole in the side near the bottom through which the water may be drawn off, will be found very convenient. If larger amounts of seed are needed it may be well to make a water tight vat holding 30 to 40 bushels. Place it in such a position that the liquid may be drawn off after each treatment.

The seed wheat after such treatment should not be put into sacks or bags that have had smutty wheat in them, as the spores of the smut plant will remain in them undestroyed. Scald the grain drill and the bags with boiling water before using them for this wheat.

THE RUSSIAN THISTLE.

This press bulletin was issued in August, 1894, but it is of so much importance that it is printed in this report.

This pest, which is not a thistle, but a first cousin to our common lambs' quarters, or pig weed, has crossed Lake Michigan and landed at Charlevoix. Yesterday, Mr. H. D. Thompson, botanist to the fish commission party now encamped at Charlevoix, sent the consulting botanist to the experiment station at the Agricultural College, three or four young plants of the true Russian thistle, establishing beyond a doubt, the fact of its appearance in our state. This weed is an annual, growing from one to three feet high, branching profusely, and when full grown, forming a dense, bushy plant, from two to six feet in diameter, and about half as high. When young, it is very juicy and tender, covered with small, narrow leaves. Late in the summer the stems grow rapidly, branching in all directions, and in place of leaves, bear spines, one-fourth to one-half an inch long. At the base of each cluster of spines is a soft, papery flower about one-eighth of an inch in diameter, ripening a single small seed. The home of this plant is in eastern Europe, or Western Asia, and it has a bad reputation in Russian wheat fields. It was introduced into South Dakota about seventeen years ago, and at present is spreading rapidly in half a dozen neighboring states. This pest flourishes best on high

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land, but will make itself at home in all sorts of soil, flourishing best in dry seasons, when growing crops cannot crowd it out. Spring plowing is favorable to the growth of the Russian thistle, because it spends a part of July and August in getting established, for flowering and seeding. Sheep are said to eat this plant until it becomes coarse and woody. Plowing in August and early September, before the plant ripens its seed, will tend to check it. The large harbors on the east shore of Lake Michigan will be the first points to be watched in attempts made to prevent the landing of this pest. A knowledge of the enemy and of the best means of fighting it must be made known at once. Small patches may be best destroyed by hand pulling, and burning every plant.

DOUBTFUL SUBSTITUTES FOR CLOVER.

The failure of the clover crop in recent years in many localities, owing to the ravages of the root borer and other causes, has induced a search for other forage plants to take its place and numerous inquiries are received by the station in regard to such plants. Those mentioned below have been employed in certain localities and for certain purposes and under the proper conditions are of undoubted value, but they cannot be recommended for general cultivation in Michigan. The station is investigating possible substitutes for clover, and remedies for the clover failure, and may in time have something valuable to suggest. Meanwhile a word of caution seems in place against expecting too much from the plants here mentioned. If the clover is found in the spring to be killed, the field may be planted to corn or sowed to millet. Omitting the clover crop for a year will starve out the borer and enable clover to be grown again. In any case one crop of hay may be expected from the clover before it fails.

ALFALFA.

The yield of this in Michigan is seldom greater and usually less than that of common red clover, while the plant itself is less desirable in several respects. The stems are rather woody and the leaves crumble badly in curing. It is difficult to get a good stand. The plants start well in spring, but in our midsummer drouths cease growing, turn yellow and become overshadowed by weeds. Alfalfa is best adapted to the south and west. It prefers a deep fertile soil, either naturally moist or irrigated. On dry soils it requires good care until its long roots have become well established. Small plots well cared for have furnished good pasture in this state, and a little of the seed may well be sown for trial with the seeds of other forage plants in a field intended for pasture. Alfalfa heaves out on heavy soils as badly as clover.

CRIMSON CLOVER.

This is proving to be a valuable crop in the middle and south Atlantic states where it thrives on soil too light for other clovers. So far as tested

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in the west and north the results have not been satisfactory. Small plots have been grown at this station for many years with no particularly promising results, as the yields have been too meager for profitable cultivation.

This season we have it growing in a plot by itself and also in a half acre mixture with other clovers and grasses. It is now (July 20) coming in flower at six inches to a foot high. Crimson Clover is an annual, living but one season, though in favorable localities it may be sown early in the fall, when it lives over winter and produces its crop the next season.

SPURRY.

This was recommended in a bulletin of this station last year as a valuable plant for improving certain light sandy soils. Many have since tested it on various soils as a forage plant with unsatisfactory results. It is too small and contains too little substance to be of value where clover or the ordinary grasses will grow. Moreover it is somewhat inclined to become a weed.

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REPORT OF APIARIST.

R. L. TAYLOR.

The apiary belonging to the Michigan State Agricultural College experiment station, was placed in my care about the 1st of June, 1893, for the purpose of conducting such practical experiments as the science of apiculture seemed to demand. The apiary, as received by me, was composed of twenty-two colonies of bees, ranging in strength all the way from very weak to strong, together with about forty empty hives, 400 empty combs and sundry other supplies for the apiary of less importance.

The practical apiarist would comprehend at once that this would be but a slender equipment for carrying out satisfactorily the object had in view. For instance in the case where last year an experiment was made for the purpose of testing the comparative advantage of comb, foundation and starters in hives for the reception of swarms, it would have required at least fifty colonies to have furnished the number of swarms needed for the work according to the rate at which bees have swarmed late years, and even then they would have been ineffectual for they would have come at times too widely separated to give value to the results; to render these trustworthy required that at least three of the swarms to be used in the experiment should issue practically at the same time. To secure this the resources of my apiary of more than 200 colonies were drawn upon. The same thing holds in other cases. Thus, during last spring, to test the value of spring protection and of stimulative feeding with a view to making the experiment comprehensive, more than sixty colonies were employed. Then, again some of the most valuable experiments made during the last two seasons, have been those concerning the so-called foul brood disease. The college apiary did not furnish the means for making these experiments, but mine did, and it was gladly devoted to the purpose.

From the first, I determined that whenever anything could be gained thereby, my own apiary should be used as freely as that of the station and this determination has been adhered to, notwithstanding some of the experiments have, as was to be expected, proved expensive.

So practically, the apiary belonging to the station consists of 200 colonies of bees and is in all respects, thoroughly equipped for practical work.

It is a matter of congratulation to our people generally that the state board of agriculture has seen fit to undertake this branch of experimental work, for it will help to give force to the truth that the prosperity of apiculture is of as much advantage to the farmer and to the horticulturist as to the bee-keeper himself.

Lapeer, Mich., June 30, 1894.

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REPORT OF THE WEATHER BUREAU.

HON. FRANKLIN WELLS,

President State Board of Agriculture, Constantine, Mich.:

DEAR SIR—I have the honor to submit herewith my annual report of the operation of the Michigan Weather Service for the year ending June 30, 1894.

Subject—Annual report of crop condition season of 1894.

The opening of the crop season was somewhat backward. Frost, cold rains and raw cloudy weather operated to retard the growth of vegetation and the usual spring work. All fall sown seed, however, had come through the winter in excellent condition and only needed favorable weather to make good growth. Fruit trees budded heavily but the cold snap in March did some damage, though not as much as was anticipated.

During the first half of April the weather was unfavorable, crop growth slow and but little farm work done. The latter half, however, gave excellent growing weather with warm showers and plenty of sunshine and the close of the month found everything progressing rapidly and prospects bright. A large acreage of potatoes was planted in the northern section and a great deal of corn ground prepared.

The month of May started in with the season about two weeks in advance of the average condition. Spring sown grain had germinated and pasturage was abundant. Corn planting began during the second week and crops generally were in prime condition. The favorable weather held out until the 18th when a cold spell set in which lasted throughout the remainder of the month. On that date snow fell in varying quantities over the state and later frost and ice formed in some localities. A general destruction of all vegetation was happily averted by the cloudy and windy conditions which prevailed during the period of greatest cold. The snow also tended to protect tender plant life. Farm work was at a standstill and corn and potato planting were delayed. The fruit prospects held good though during this time and at the close of the month promised well.

The first week in June showed no change from the May conditions. Crop growth was checked and in some portions fruit, berries, garden truck, potato, tomato, onion and corn plants were injured by frost. The advent of warm weather was not much longer delayed and the latter part of the following week showed a marked improvement. It warmed up and the soil dried out, making it possible for the farmers to get out into the fields and finish up the planting of corn and potatoes which work was

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done by the middle of the month. Small berries ripened fast, wheat began heading out in the southern part of the State and fruit set well. The growth of grasses was poor and oats were a light crop. The weather continued fine during the balance of the month and the growth of all classes of crops was very satisfactory.

During the first decade in July the crop conditions as compared with the same period for 1893 showed hay a short crop, wheat harvest earlier and heavier, quality as good, oats quality better but yield about an average, rye and barley about an average crop, corn and potato condition average. Haying was finished about the 8th and wheat harvest became general during the second week. It was about this time that the great drouth set in which prevailed without intermission practically until the first week in September, a period of nearly nine weeks, and which has passed into history as one of the dryest seasons ever known in this state. During its continuance pastures burnt up, small streams disappeared, and in many cases water for stock had to be carried long distances. Corn, beans, and garden truck shriveled up and potatoes, beets and turnips dried in the ground. The conditions were fittingly described by one correspondent who on August 18 reported "no rain, no corn, no potatoes, no encouragement." Forest fires became frequent during the latter part of August and added their quota to the prevailing distress, destroying fences, orchards and standing timber. During this period wheat and oats were harvested and threshed, much of the corn was cut for fodder, and all that was left of the bean crop picked. Fruits, especially along the Lake Michigan shore, stood the drouth well and a large crop of peaches, pears, cherries and plums was secured. During the week ending September 8 heavy showers fell over the state, breaking the long spell of dry weather and doing an immense amount of good to late corn and potatoes and to pastures. This and subsequent rains saved the remnants of these crops and enabled farmers to begin their fall plowing and seeding which by this time was much delayed. This work together with cutting corn and digging potatoes, was followed until the end of the season, the last bulletin for which was issued on September 29. In summarizing the conditions which prevailed from the beginning to the end of the season the following extract from bulletin No. 26 says: "That notwithstanding these depressing and destructive influences, a large percentage of our farmers harvested fair crops of all products except corn, potatoes, beans and buckwheat, and that the season ends with favorable conditions of weather and soil for such fall work as yet remains to be done."

The work has been carried on by the undersigned as director, assisted by Mr. E. H. Nimmo, an employe of the U. S. Weather Bureau who has been detailed for the purpose. During the period from November 8, 1893, to March 5, 1894, Mr. Nimmo was on duty at Columbia, Mo., and his duties here assumed by Mr. C. F. Schneider.

Owing to the failure of the last legislature to make any appropriation for the support of the service, the work has been much crippled, and many lines of investigation which promised valuable results, contingent upon support from the State, had to be abandoned. I have therefore confined the work entirely to the collection and compilation of the meteorological and climatic conditions of the State with the hope that at some future time funds will be available to allow of their publication in a form most adapted for practical and intelligent use.

Through the co-operation of the National Weather Bureau much has

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been accomplished that would otherwise have been impossible. Liberal aid has been given in keeping up and extending the daily forecast service throughout the State and at present there are 60 places receiving such messages, the expense of which for both flags and telephone or telegraph service is defrayed by the National Bureau. To further aid in the dissemination of weather warnings there was put in force during the year a system of "logotype forecasts," by means of which 48 places have been added to the original list. This has been made possible by the co-operation of the postmasters at the points where these forecasts are displayed.

Various railroads in the State are also posting the weather report daily at many of their stations. The list of roads aiding in this matter are: C. & G. T., D., G. H. & M., C., S. & M., D., L. & N., T., A. A. & N. M. and the T. & S. H. Under this sysetm 225 towns are receiving the benefit of daily weather predictions.

The monthly reports are printed by the Secretary of State, being incorporated in the crop report of the Bureau of Farm Statistics issued by the State Department. Four thousand copies are issued each month.

During the crop season of 1893-4, the national bureau authorized the printing at its own expense of a weekly crop bulletin showing the effect of the weather on the crops and the condition of the crops from week to week. This publication has been of immense value to the agricultural classes and has met with hearty appreciation from them. Eighteen thousand and two hundred copies of this publication were distributed.

To further spread the information of local climatic features the voluntary observers have been encouraged to publish their observations in the nearest local paper, together with such remarks as would be pertinent in each case. This has met with much favor in all cases where it has been adopted and it is intended to make it general if possible.

Arrangements were made with the "Michigan Farmer" to publish in full the remarks of our crop correspondents each week and by this means a circulation of 13,000 copies was secured. The same idea was also followed in the case of newspaper agencies, notably the Western Newspaper Union and American Press Association. These gave the service the command of about 100 papers in which our reports appeared weekly, reaching thousands of our farmers and enabling them to judge of the crop conditions in localities other than their own.

In considering ways and means for utilizing the data collected through eight years of continuous observations, especially in regard to what our varying climate is best adapted to produce, the director has been impressed with the opportunities which exist for increasing our knowledge of the weather conditions most favorable for the growth and development of fruits and potatoes. The latter it is thought offers a particularly fertile field for investigation. The subject of proper conditions of atmospheric moisture and temperature and of sunshine, as well as soil temperature and moisture, and the bearing these have in producing a perfect article, is of immense importance and presents a legitimate line for work. The Michigan potato is a commercial factor of no small importance and a good of bad crop means a difference of many thousand dollars to our farmers. Is not, therefore, any knowledge which tends to increase the output, which tends to show where our climate is most favorable for its growth, or which tends to minimize unfavorable conditions, of the utmost value? It appears to the director that [the accomplishment of this end is entirely feasible. Unquestionably the field is a great one and no doubt but some disappoint-

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ments would crop up in getting at the truth; but the germ is there and with time, patience and care it could be brought forth.

It has been a matter of great gratification to the director to note the zeal and efficiency with which the voluntary observers and crop correspondents have performed the duties which they voluntarily assumed. Without hope or thought of compensation they have given their energy and in some cases their money to keep up the work. When the great mass of data which they have been engaged in accumulating shall have been sifted and compiled and assisted in determining with greater accuracy vexed questions of climate, especially as related to crop growth and possibility, their reward will be in the knowledge that they have aided in that end. It can truly be said that their work is a monument to their faithfulness and ability, and without a parallel in the history of state weather service work. The director also wishes to acknowledge to the members of the State Board of Agriculture individually and collectively his appreciation of, and indebtedness for the hearty and unwavering support they have always given him. Without the aid and encouragement they have extended circumstances would long since have made it impossible for the organization of the service to have held together. Therefore with a thorough appreciation of the confidence which they have shown in his administration of the service, and earnestly hoping that nothing may mar the present friendly relations which exist, this report is respectfully submitted.

EDWARD A. EVANS,
Local Forecast Official and Director.

Detroit, Michigan.

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MISCELLANEOUS ARTICLES.

THE VITALITY OF SEEDS BURIED IN THE SOIL.

BY W. J. BEAL

In the summer of 1879, fifteen years ago, I buried seeds as follows: Twenty lots, fifty seeds in each of twenty-one species of plants, mostly weeds. Each lot of seeds, with one exception, was well mixed with damp sand dug up from three feet below the surface, and placed in an 8 oz. bottle. The seeds were well mixed in the sand, the bottle left uncorked and placed with the mouth slanting downwards, buried twenty inches below the surface of the ground in a sandy knoll. The acorns were not placed in bottles.

At the end of five years, and again at the end of ten years, sets of these seeds were tested for vitality and the results given at previous meetings of this society. Another lot was dug up and the contents of a bottle moistened on May 25, 1894. Seeds soon began to come up, and probably will continue to germinate for some months yet, if we judge by former tests. This report then, is not complete, but may interest you. It gives results up to August 10.

	Number of seeds germinated.
Amarantus retroflexus (A pigweed)	1
Ambrosia artemisiæfolia (Ragweed)	0
Brassica nigra (Black mustard)	4
Bromus secalinus (Chess)	0
Capsella bursa-pastoris (Shepherd's purse)	21
Erechthites hieracifolia (Fire weed)	0
Euphorbia maculata (Spotted spurge)	0
Lepidium Virginicum (Pepper-grass)	17
Lychnis githago (Cockle)	0
Anthemis cotula (May-weed)	5
Malva rotundifolia (Mallow)	0
Oenothera biennis (Evening primrose)	6
Plantago major (Broad-leaved plantain)	1
Polygonum hydropiper (Smart weed)	4
Portulaca oleracea (Purselane)	9
Quercus rubra (Red oak)	0
Rumex crispus (Narrow dock)	7
Setaria glauca (Pigeon grass)	3
Stellaria media (Chickweed)	3
Thuja occidentalis (Arbor vitæ)	0
Trifolium repens (White clover)	0
Verbascum thapsus (Mullein)	18

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I may say that there is some doubt as to the exact number which should be credited to Pepper grass, Shepherd's purse, and May weed, but I have no doubt that several of each of these germinated.—*Agricultural Science.*

THE VITALITY OF CLOVER SEED.

BY W. J. BEAL.

In September, 1882, I selected of the second crop of red clover five plants within ten feet of each other, which seemed to be much alike. The seeds of 50 good heads of each plant were shelled and ever since have been kept, each lot by itself, in glass bottles. During most of this time the bottles have been exposed to the light.

On June 7, 1894, nearly twelve years later, 50 seeds of each lot were tested with the following results:

Of number	1	24	germinated.
"	2	8	"
"	3	34	"
"	4	25	"
"	5	0	"

On June 23, 1894, another test of 50 seeds each was made:

Of number	1	21	germinated.
"	2	10	"
"	3	32	"
"	4	21	"
"	5	4	"

This is an average for both tests of 35.8 per cent in each lot.

On examining the seeds of lot No. 5, they appear quite dull in color, and give me the impression that they were placed in the bottle before they were perfectly cured. Each bottle contained only from 1260 to 1820 seeds. The bottles were all alike and would when full, hold several ounces. They were stoppered with ordinary corks.

Discussion: Mr. Echols asked, "How do you account for the difference in the germination percentages of these lots of weed seeds?"

Mr. Beal replied that there may have been some difference in the pressure of the sand used in packing and therefore a difference in aeration. The germination in most cases was very slow.

Mr. Saunders said that he had observed that, in raising grape from seed sown out of doors, the seed not germinating the first year, usually germinated the second, though sometimes not until the third year; that it might therefore be found that a longer continuance of the test would lead to a closer agreement of results. Then, too, there are varietal differences in this function. It has been observed that, under the conditions of the malting house, six-rowed barley germinates six hours later than two-rowed barley.

Mr. Galloway remarked that a difference in the size of the seeds might

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account for some of the variations. As a rule the smaller sized seeds of the same variety germinate the more slowly. "Peculiar variations are sometimes found. In the cases of seeds usually germinating in four days, I have had germination delayed for twenty-five days—as in case of radishes, lettuce, etc. In the case of radishes, four crops in a season can be secured by use of large seed, and even five crops if over half the seed be rejected and the plants be forced. It may be of interest to observe in this connection, that although the larger seed has given the greatest weight of total product, the larger individual plants were obtained from the smaller seed. Two elements of the seed affect the final result: the amount of food stored up and the inherited potentiality; the latter factor seems to be greater in the smaller seed."

Mr. Beal then called attention to a remarkably long spike of common timothy picked by a student from a piece of Lathyrus sylvestris, a new forage-plant much talked of. The spike was 12½ inches long when dry. In reply to the question, "Are there varieties in timothy?" he replied: "Yes; possibly races. There is, for example, a Russian variety which is more slender in stem, leaf and spike than the one usually grown."

Mr. Rane stated that he had given some attention to this question and had found in West Virginia, growing upon the same soil, at least three distinct varieties of the species.

Mr. Saunders said that in Canada they had tested the reproductive qualities of seed from long-heads of timothy as compared with those from short heads, but found no peculiarity in the offspring.—*Agricultural Science.*

WHAT'S THE MATTER WITH FARMING?

BY HON. WILLIAM BALL.

[Read at farmers' institutes at Stockbridge, Niles, Cassopolis, South Butler and Ithaca.]

That something is the matter with it is abundantly proved by the derangement, apprehension, dissatisfaction and agitation prevalent throughout the whole country. By the great depreciation in farm property, stock of all kinds, and especially in wheat and wool, the farmer finds himself in a condition pecuniarily that is anything but pleasant and hopeful. Formerly these products have brought a fair price and those depending upon their sale were enabled to carry on farm operations successfully, build necessary buildings, support the family, educate the children and lay by a fraction of the proceeds as profit. Under present conditions, curtailment in expenditure is the order of the hour. Improvements necessary for the success of the farm are neglected. Distrust and suspicion of the future prevail, and farmers as never before are at a loss for a solution of the difficulties, and are hoping for some remedy. In order that a possible solution may be found and remedies applied, it is necessary that the whole field be looked over, and then perhaps nothing substantial will be the result.

One will not be expected in a paper of ordinary length, for an occasion

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of this character, to go into detail, but point out as far as may be some of the conditions that surround us, and see if something of value may not be gained in a search among the ruins of former agricultural prosperity. For years past farm property has been steadily depreciating in value, while real estate in villages and cities has correspondingly, or in greater degree, increased in value. The last census shows clearly that while cities and villages have increased rapidly in population, the country, especially the older settled portions, has been gradually decreasing in population. A portion of the increase in towns and cities is due to immigration, some to the natural increase, and quite an amount by the exodus from the country.

With these things being true, and while farm labor has been higher than formerly, and crops poorer in quantity, the prices have been steadily growing lower, until the amounts raised and the amounts received therefor, the average farmer is barely able to make the farm pay the expense of working it and have a moderate amount left for a living.

As farmers, we know the condition of things, we feel its crushing influence, and ask ourselves why is it so, and how long will this condition of things continue. I answer, just so long as the same conditions prevail, unless a change in our methods and practices in our farming operations occur. The practical engineer, finding that his engine does not perform its usual duties, at once endeavors to ascertain the difficulty, and having found it, applies the remedy. If a corporation finds that the course being pursued is creating a loss to the stockholders a halt is called, the reason ascertained and a change made. It is comparatively easy for an engineer who has entire control of his engine to find the cause for failure of performance and apply the needed remedy. It is also easy for a corporation to detect errors in business and correct them, for the managers have all the details of the business in hand, and can easily find out the weak places in the management; but when we come to farming operations scattered over so vast an extent of territory, varying so much according to the conditions of climate, soil, and location, conducted without any concerted action, without method, and frequently without intelligence or energy, it is very difficult to arrive at causes, even approximately, or to apply remedies that will be general in their application. Remedies applied at random for difficulties not well understood are apt to be worse than the difficuties they are intended to relieve.

For a number of years past a species of discontent has been fomented among formers by men who have gone abroad over the land proclaiming that the farmers were being ground down and impoverished by moneyed monopoly, by railroad extortion, by adverse legislation, etc., etc., and that the trouble lay in these corporations and that by proper legislation for the benefit of the agriculturalists as against these concerns would remedy the evils, and as a result better prices would be realized for farm produce, more money would be in circulation and prosperity would be speedily established. Thousands of farmers have believed these statements to be true and have become discontented, have neglected their farms and become clamorous in their demands for a change in the management of national matters. The change has been made, legislation enacted and in the process of enactment; but with every piece of legislation matters have become worse, and the conviction is forcing itself upon the minds of thinking, intelligent men that the trouble does not lie in that direction. The less legislation upon certain matters for special purposes the better off will be the general interests of the country. There is one result that the wails of distress made by

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the traveling statesmen alluded to have made clear: and that is, the credulous farmers and laboring men have furnished a good living for them out of their hard-earned money, and plenty of funds for their traveling expenses; while the causes for discouragement remain in full force, and will until the thoughtful farmer begins to study the causes for himself, rather than rely upon statements made by men who make them in most instances for selfish and political purposes.

While I do not dissent from many of the views expressed about the power of money in influencing legislation and in keeping under control matters essential to the prosperity or adversity of a nation, still I believe that many of the methods suggested would be injurious to the prosperity of the country were they adopted. To no one cause nor even a limited number of causes can be ascribed the agricultural depression that now exists.

As said before, the last census shows that the farming communities have been losing in population. Some of this loss has gone to swell the population of towns and cities. For the last ten years or more many of our most enterprising young farmers with their families (if they had them) have gone to the rich farming lands of the west; where, by the generous action of our government, a comfortable home of 160 acres of land has been furnished free to those who desired them upon the condition of occupancy for a certain period. Within the period mentioned millions of acres of these excellent farming lands have been improved and cultivated. Immense numbers of cattle, sheep and horses, also vast quantities of wheat and wool have been raised and have come into competition with our products of a like nature. Added to this, extensive wheat areas in India have been developed and the wheat (produced by labor worth from eight to fifteen cents per day, upon these lands without much value), has been brought to the seaboard by railroads recently constructed by Great Britain and have come into competition with our wheat of late, all tending to make the supply greater than the demand, thereby reducing the price to a point below remunerative production.

The rapid increase in the production of fine wool in Australasia, South America and Southern Africa within a few years, the cheapness of its production on account of the ownership of immense quantities of land and immense multitudes of sheep by a few of the aristocrats of those countries, together with the cheapness of the land and most of the labor employed has also had a tendency to cheapen the price of American wool. These foreign wools can be produced and sold for a less price than the American farmer can produce them. The United States do not produce only about half of the wool they consume. Were the conditions favorable they could as well produce the other half, which in self preservation they ought to do.

The uncertainty of legislation which affects the importation of foreign wool and woolens has had and is having a depressing effect upon wool and sheep raising in this country. How long this uncertainty regarding such legislation will last depends upon the lethargy or activity of the Solons in Washington who yearly and sometimes oftener congregate there. Uncerainty seems to mark all their proceedings. For the good of the country they should bottle up their long-winded speeches and do what legislating they are going to do which affects the industries of the country. It is not the province of this paper to discuss protection or free trade, but I believe I echo the sentiment of every thinking man in this audience when I say I wish some other than the present time had been selected to experi-

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ment upon the two systems of protection to American industries or free trade with the competing products of the nations of the whole world. Some of the causes for low prices and stagnation in farm productions have been mentioned and there are others which should be mentioned. It seems to me that enough has already been shown to prove that one great cause for the low prices of wheat and wool at least is the keen home and foreign competition, remembering that whatever the legislation, much depends upon the law of supply and demand. Unquestionably the gambling on boards of trade, the manipulations of the prices of cattle, sheep and swine by the large cattle syndicates have something to do with low prices of nearly all the farmer has to sell, but the facts show that competition in farm productions have the effect to cheapen the products in the same manner that keen competition has lowered the prices of almost every variety of manufactured goods which farmers buy.

These facts are before us, and are sure to become permanent. The uncertainty and distrust which prevail in farming operations are affecting all other business interests of the country. This in itself is a depressing influence, for with the inability to purchase, less will be bought, less worn, and less consumed, all working together for evil. Agriculture must stand its share of the consequences. It does no good to say that farming operations are in no worse condition than other branches of business. The fact is patent that something is the matter with farming, and that it is not yielding to the producer a fair recompense for his labor and investments. Successful manufacturing and mercantile operations have all been conducted upon strictly business principles, with skilled labor well paid, and upon an economical basis as regards materials, time wastes, etc., with a proper division of labor. The best talent to be found has been employed in building and running the vast systems of railroads, the building and operating the thousands of miles of telegraphs and telephones. Skill, untiring energy and making everything connected with the great slaughtering establishments subserve some purpose commercially; and while almost every corporate enterprise has been made remunerative by system, economy, and a proper regard to all necessary details, the farming operations of the United States have in the main been managed in a haphazard manner without system or intelligent organized effort, with a seeming indifference to the results which must follow such a course. The time was, when competition was light, the soil new and fertile and the demands upon the resources of the farm much lighter than now, when farming conducted in the manner indicated might pay, in spite of neglect to system and intelligence. That time has passed, and will never return.

Farmers, like other business men, must manage their farm operations with intelligence, skill and economy. This can be accomplished only by careful study, comparison by systematic methods, by co-operation and by a judicious use of time during the whole year. Co-operation can be accomplished only by organization. Organization in conducting farm work is as essential as a board of bank directors in banking pursuits or boards of directors in any other business enterprise. These statements are made with the full knowledge that one of the remarkable agricultural lights of the age proclaimed in one of the sessions of the World's Congress that organizations were the farmers' worst enemy.

This marvelous agricultural light is a product of Michigan. From this intelligent source the farmer is advised to read some daily newspaper as a guide in his agricultural operations. For theories of government he is

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advised to consult Adam Smith's "Wealth of Nations," a production which teaches that the way for nations and individuals to grow rich is to open its ports to all the cheap products and cheap labor of the world, so that they may come into competition with similar productions here produced upon higher priced lands and by better paid labor, on the theory that the greater the quantity of the competing products the more money they would bring.

With such an ignoramus and pettifogging politician at the head of a department of the government (which would not exist today had it not been for the hard work and persistency of the very organization he so ignorantly condemns) the farmers have little cause for rejoicing. Every farmer in this broad land, be he republican, democrat, prohibitionist or populist, should unite in a demand for the dismissal of this high-toned demagogue from the important position which he so flagrantly disgraces. The proposal to enlighten intelligent farmers what they should read or to what they should or should not belong, is an insult to agricultural intelligence and worthy a Shakesperian Falstaff. Farmers should not only read daily papers, but they should be well supplied with all the literature applicable to their business.

Instead of destroying farmers' organizations they should be increased an hundred fold. Every township should have one or more farmers' clubs where are discussed the best and most approved methods in farming, the markets, its conditions as relates to the requirements of the world and the supply to fill such requirements, as well as intellectual and social subjects, which are beneficial in every well regulated neighborhood. In a manner I have pointed out what seem to me some of the potent causes for agricultural depression, namely strong competition arising from a large surplus.

The uncertainty of financial legislation, a lack in business methods of the farmer, a disregard of a systematized policy, and a misuse of time, as well as a lack of comprehensive knowledge of the present needs of agriculture. Added to these may be a lack of a sufficient amount of circulating medium, and also the fear and distrust arising from a threatened change in the tariff laws. The remedies for the present depressed condition in agriculture are as various as the parties making them. A large number believe that the remedy lies mainly in the form of legislation. To a limited extent I believe this to be true. The laws of this country should be so framed that an alien should not have an advantage over the American farmer in the markets of this country which he in no way helped to make, and which he would have if allowed to sell his products which compete with ours on an equality. If protection is afforded to one form of labor it should be alike to all. The law should protect the individual citizen against the encroachments of corporative capital. One great trouble with most of the legislation nowadays is the fact that most of it is enacted to suit party requirements rather than for the general good. Patriotism to country and general prosperity is lost sight of in the struggle for party supremacy. I apprehend that outside of a certain amount of legislation affecting our monetary matters and foreign imports, that the less special legislation enacted the better it will be for the whole country. A great deal has recently been said by our wise financiers and an enlightened press about the repeal of the purchasing clause in the Sherman bill. Dire results were prophesied in case of a repeal and equally bad results if not repealed. One would suppose from reading the speeches pro and con, as well as contributions from editors on finance, that the whole monetary fabric of this government was on the point of dissolution.

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The repeal took place and not a ripple appeared upon the suface of the financial sea. Everything is as quiet as if it had never happened. I do not know of a farmer who has been benefited or injured. The hundreds of campaign speeches made will be lost sight of in the struggle for bread. After all the benefits that may be derived from legislation the main remedies must lie with the farmers themselves.

The methods pursued in the past will not do for the present nor the future. The needs of agriculture must change to comply with the changed conditions in all other business. The business operations of the world are being reduced to a science. Farming operations in the future to be successful cannot prove an exception. The conditions surrounding localities must control to a certain extent the operations on many farms. Special farming in the localities near large towns and cities will prevail. Intensive farming is already carried on in many of the eastern portions of the country with good results. The methods to be pursued in this system of farming must be such as science dictates. In many departments skilled labor is essential. Economy in time and expense must prevail in every department on a well managed farm. A thorough knowledge of the capabilities of the farm should be understood and crops grown that are best adapted to it and the markets. The farms lying outside of the more favored ones must be managed under the same general rules as those nearer town. While not raising the same crops to any extent, perhaps, what are grown should have the same care and intelligent culture as those nearer market. The fertility of the soil should be continually increased. This fertility should be kept up by home-made or barnyard manure. Stock enough of the different varieties should be kept on the farm to accomplish the object. Artificial manures as a rule are not to be recommended. They vary so much in their combinations and there is so great a variety of soils even on the same farms, and the seasons are likely to be so varied that no definite results can be relied upon. Clover and barnyard manure contain more of the requisite ingredients for enriching the farm than any other form of manure from the fact that they were made from the crops natural to the farm. The farmer of the future must be a student of the markets as well as a practical business man.

One of the urgent needs of the present is a more diversified system in agriculture. A better knowledge of the different kinds of crops grown, the quantities required, and where they can best be cultivated, is one of the necessities incident to intelligent remunerative farming. A great deal is said about foreign markets for our surplus agricultural products. Too little is said or known about the large amounts of agricultural and other products imported into this country which we had better raise and manufacture at home. The following statements would hardly be believed were they not authentically made by the United States Statistician, J. R. Dodge, who has filled that responsible position for the last 20 years. Referring to the subject of exports he says: "So much has been boastingly said in true spread-eagle fashion of our 'feeding the nations' that it may have quite escaped public attention as to the nations feeding us, and the variety and quantity of such feed. Doubtless few realize it as pretentious writers have sometimes declared, with gross inaccuracy, that one-fourth of our agricultural productions are exported, whereas our surplus is only about one-tenth of the production. Instead of obtaining all our food supplies from our own lands and waters the imports of sugar, fruits, wines, breadstuffs, meat, eggs, dairy products, vegetables and fish cost us half the value of

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our cotton crop, which nearly supplies the factories of the world. Just as the cotton districts pay out so large a share of their proceeds of cotton sales to buy 'hog and hominy' and the commonest of plantation supplies, just so a large share of the so-called agricultural surplus of the United States goes to pay for foreign products of the same class and kind as those we produce insufficiently here, as well as for those which are not produced here. Therefore, our exports are not a surplus at all, and the net surplus is reduced almost to zero." This quotation is given to show that while we export considerable of our farm products, almost its equal is imported. The lesson to be learned is that these necessities of life should all or nearly all be raised here and sold for home consumption. Freights and middlemen's charges could be saved and the result would be an increased price for home productions. According to the same authority, we "find the amount of food supplies imported last year to have been in the aggregate $153,569,280, besides the amount of farm animals amounting to $1,675,803. Of textile and cordage filbers there were imported an aggregate value of $66,000,000. In addition to manufactured fibers there were imported a value of $35,000,000 of wool, $28,000,000 of cotton, $26,000,000 of flax and hemp, all of which should and could be produced in this country if conditions were favorable and farmers and manufacturers better understood and utilized the advantages at home." Again he says in discussing the tendency of following in old ruts of agricultural production: "The south sticks to cotton, the middle and west to corn and hogs, the northwest to wheat, and sell cotton for 7 cents per pound, wheat at 45 cents and corn at 15 cents per bushel, and pertinently asks and answers the question, 'how is this state of things to be remedied?' 'By thought, invention, science, skill, enterprise, with a little safe radicalism in crop innovations.' While tobacco is one of the staple products in many parts of the United States there was imported of that production $10,382,423 worth. Of hides, $26,658,133; seeds, to the amount of $2,264,837; hops, $883,701; feathers, $904,656, and of hay, $715,151 worth, and this does not exhaust the list of the imported articles which this country should produce." These statistical facts are given to show the difference in the actual amounts of our imports, and what is claimed to be the truth, and which shows conclusively that there is a vast field for scientists and thinking men to cultivate. Also to call the attention of the American farmer to the fact, that if he is (in the future) to be prosperous by his profession he must understand in a clearer manner the varied wants of the world's markets, the capabilities of his farm, and the best methods to be used in bringing about profitable results. What has made corporations prosperous and wealthy is due in a large degree to the knowledge of all details necessary in the conduct of the business engaged in; to the proper division of labor; to the employment of men skilled in these different divisions who direct the unskilled workers. To the economic use of time and material. Skilled labor in agriculture will in the future be more indispensable than in the past. A more comprehensive knowledge of soils, seeds, climatic conditions, a better utilization of time and labor coupled with a determination to succeed.

Every farmer should take an inventory of his time and the capabilities of his farm. He should not rest until he has discovered the weak places in his farm management and set about applying the remedy. If he has been negligent and careless in his management of the farm, he should work

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with care and skill. If has been in the habit of buying tools and letting them decay more by exposure when not using them than by their careful use he must change his method and house and care for them as having a value that he cannot with impunity disregard. If he has been in the habit of poorly farming a large number of acres and receiving a correspondingly poor return in crops, he must cultivate half the amount of land with the amount of care and labor essential, and have the other half for pasture, thereby increasing his returns, besides feeling better as his improvements go on. If he has been in the habit of breeding and keeping scrub stock of any or all kinds, he must change his method and breed only the improved sorts; breed for the purposes he desires, and feed them well; remembering that it is not the numbers of his flocks or herds that tell, but the quality and the prices they bring.

There is no class or breed of domestic animals today that have not the stamp of improvement upon them put there by some painstaking and thinking breeder that will pay the owner to feed and propagate. The sort or sorts to be kept should be such as have been bred in the direction of improvement that is desired by the owner. If for draft, specimens of horses excelling in that direction. If for speed and road qualities such as show that kind of breeding. If for beef, some one or more of the improved beef breeds. If for the dairy, such as are by breeding and feeding adapted to the particular wants of the owner. If for wool growing, that breed of sheep which have been especially bred for wool production. If for mutton, then one should select some one or more of the breeds of sheep which produce the most mutton at the least cost, and so with swine, remembering that as much of all improvements in stock breeding is largely due to good and generous feeding, a lack of such care will as surely result in deterioration and loss. If the habits of the farmer have been extravagant he must economize. If he has spent several months in the year simply waiting for spring to come he must utilize the wasted time to the advantage of work on the farm the following season.

These suggestions are all essential to progress and future success, and while the field is too large to be treated as it should be in one paper, still I hope the time spent in listening to its reading will not have been all in vain. I cannot conclude this paper in a better manner than by quoting from the remarks on this subject by the same authority from which quotations have already been made. In treating of the exports and imports, he says: "The American farmer has arrived at the forks of the road of progress, the parting of the ways. One leads to the diversification of products, economy in processes, skill and taste in preparation for market, and commercial acuteness in finding the best market. The other is the old road, rough and rocky, and more than ever a hard road to travel." The question is, farmers, "which road will we take?"

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HOT WATER AS AN INSECTICIDE. *

BY G. C. DAVIS.

I think you will bear me out this afternoon in my statement that the simplest things of life are often the least known. We strive and toil for things unattainable when commoner things would serve our purpose as well, if not often better. We long for the things we have not, unmindful of what we have, when if we would devote our attention to what we have and make it subservient to the best of our knowledge, we would be surprised at the satisfaction and contentment drawn from this illimitable source. A farmer may feel discouraged to grow his crops with the few tools he possesses while his more wealthy neighbor has all the latest and most expensive implements, yet tact and good judgment, which a farmer of moderate means almost always possesses, will enable him to use his tools to such an advantage that he will have the superior crop at harvest. The housewife may long for the roomy city mansion for a home, yet if the most is made of her own surroundings, simple though they be, that home will give more sunshine than the stateliest mansion can. Again, who has not seen the time when the knowledge of some simple little antidote was of more worth than a skilled physician when he came?

Our subject before us is upon one of these simple things. Water is so common and its use so little thought about that we are not apt to stop and consider its value as an insect remedy, although it is a most valuable one. It is always at one's command, costs nothing, and with a few moments' heating is ready for application. It leaves no bad effect upon the plant if not raised to too high a temperature and none need fear poisoning by consuming the treated plants.

An insect is unable to endure as great heat as a plant, 130 or 135 degrees F. is sure death to most of insects, while few plants are harmed by water at 150 degrees, the scalding point. Even the colias, the most delicate of house plants, is not injured by water at 150 degrees. This gives a range of at least 20 degrees between the killing power upon insect and plant. On hardier plants the range is still greater. I know from experience that water at 180 degrees will not injure cabbages and presume the temperature might still be raised with impunity.

Hot water finds its greatest usefulness as an insecticide where it is to be applied in a very limited way. Used upon a large orchard or upon several acres of cabbages or vines, it is doubtful whether there are not other remedies more practicable. Extensive use is greatly depreciated in constantly keeping it at the proper temperature. Many other difficulties enter in which are hard to obviate. The most important one of these is time. The time consumed in heating the water, getting it to the place of use and keeping the temperature at the right point is greatly increased at each step. On the other hand, one with a few plants can run out with a pail or sprinkler and quickly give the plants a hot water bath. For the farmer with his own little garden or a few bushes that may need treating, hot water is his Utopia and almost a panacea.

* Read at Ingham County Pomona Grange.

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In making a specification of the insects to be treated by this remedy, the common cabbage caterpillar, often called the green cabbage worm, ought probably to head the list. It is very susceptible to the hot water and the plant is the converse. Almost every one has some special remedy that he or she considers very good, but if hot water is once tried it will be used again. While out on institute work last winter, I learned that many farmers used Pairs green as a remedy. There probably is little danger in a careful use of it in this way, but it hardly seems advisable to recommend its use with better, simpler, and less dangerous insecticides at command.

By occasionally placing a thermometer in the heating water, the desired temperature can be very easily obtained. It should be raised somewhat above the desired point if likely to cool much through transferring or through carrying quite a distance. Water cools quickly—much faster in tin than wood—and should be applied as rapidly as possible when ready. The application may be made by means of a cup or through a sprinkler with the cap removed or a spray pump without a nozzle or in any manner that may seem most convenient. The water can not be thrown in a spray, but must be thrown in a solid stream else it will lose its temperature to such an extent as to become ineffectual. The effect is immediate and certain, the caterpillars succumbing at once.

By the use of this one simple little item the farmer can raise his cabbages to a better advantage than the special huckster.

Another insect upon which hot water can often be used with good effect is the rose chafer. This hard shelled, rather slender, long legged beetle is a much greater pest in the east than here, but with us it often injures rose bushes, grape vines, peach trees, etc., by stripping them of their foliage, and worse still, of their blossoms and fruit. Our poisons that we usually expect to kill all such insects are ineffectual here. An Eastern entomologist says they will eat Paris green with an apparent relish and grow fat on it—probably considering it as a condiment that the farmer has added for the special occasion.

We found last year in our experiments that kerosene emulsion when thoroughly applied would kill the most of the "chafers" and that pyrethro-kerosene emulsion was still more effectual. When hot water at a temperature of from 130 to 140 degrees was poured onto them, they yielded to the inevitable without a struggle. For a peach orchard or large vineyard, one of the forms of kerosene emulsion is to be recommended, but for the rose bushes about the house, a few grape vines or peach trees, hot water is the remedy.

From various parts of the State came reports last year that the yellow-lined currant bug was doing much injury to the currant bushes. Kerosene emulsion and hot water are both effectual upon this pest when they strike it. As the big brown squash bug is so nearly like the currant bug, we felt confident for a while that we at last had a good remedy for it, but upon experimenting a little, we found that it took water at 165 degrees to make the bugs bow in submission, while above 150 degrees cooked the squash vines. We are still looking for a remedy. Hot water is also excellent in treating the pests that are found upon house plants. The little green plant lice, the white mealy-bug and other such forms quickly die under its influence. Insects working under ground on the roots may often be dealt with in a similar manner. In such a case the water should be almost at the boiling point before applying and then soak the soil with it.

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There are many others, perhaps less important, insects for which our same allopathic treatment can be made valuable. If I have given enough to show you the principle in the merit and importance of so simple yet effectual a weapon as hot water in your insect warfare then I can safely leave all the delineations and specifications to you, for I know there is not one here who does not know as much about hot water as I. Is it too simple a remedy to give it a trial?

INSECT CONTROL. *

BY G. C. DAVIS.

As each succeeding season comes and goes, we see a greater need and find an increasing demand for better insect remedies and a surer means of insect control. After each season has passed we find we have to add to our already large list new injurious species for which we must find suitable remedies. We also find in looking over the season's work that we have here and there found better means of control by having a superior knowledge of the insect and its habits or better methods in applying remedies that will make them more efficient, or often by finding some effectual insect remedy that is new in insect warfare. With this in view and knowing that you as an intelligent class of farmers wish to know the latest and best methods I will try this morning, in a brief way, to accord with what time I have to give you the best means of control as adopted by farmers and etomologists over the United States. If there are any who have remedies that they have found superior, we hope they will report their experience, as this is one of our means of securing the best.

We may divide our control of insects into two general divisions; our remedial measures by which we apply some remedy directly to the insect, and preventive measures by which we prevent insects from becoming numerous enough to be injurious.

THE ARSENITES.

We will first consider the remedies, beginning with the arsenites. These include the old standbys: Paris green, London purple, and also white arsenic, which is sometimes used because it is cheaper, but, as it is much inferior to the other two, it is hardly to be recommended.

The arsenites are often used in the powder form with lime, plaster or flour, and about the best rule that can be given in the proportion to use, is to combine them so that only a very faint green or purple tint will be seen in the white diluent. This will make the poison in the proportion of one part to one hundred or one hundred and fifty. The mixture should then be dusted over the plants. Air slaked lime seems preferable of the three diluents given, as it will in a large measure prevent the burning of the foliage should too much of the poison be applied.

* Read at farmers' institutes at Allegan and other places.

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Usually the practice among farmers and fruit growers is to apply the arsenites in water as a spray 1 pound to 200 gallons of water, or 3 ounces to every 40 gallon barrel, seldom burns the foliage and proves effectual on the leaf eating insects. Paris green is less liable to burn the foliage than London purple and is for this reason the safer to use where it is to be used alone in the water.

Many draw-backs and disappointments have been met with by using the arsenites alone in water, as they would at times burn the foliage even with those who had been the most careful and exacting, as I presume. many of you know from experience. This naturally caused many to discourage the use of them, but now we have that difficulty obviated so that there is no excuse for injuring the foliage. It is by adding a little milk of lime to the spraying mixture. Both of the arsenites are mostly insoluble in water, but there is some soluble arsenic and this amount varies in different samples you may obtain at the stores. London purple contains more soluble aresenic than Paris green, and for this reason it is the more liable to burn the foliage because it is the soluble arsenic which does the harm. The practice has become general now, where known, to add a pound or two of fresh slaked lime to each barrel of water used. The lime can be very quickly slaked in a box or pail and made thin enough so that it can be strained through burlap, or some coarse material, to take out the dirt and impurities, else it would clog the pump and nozzle in spraying. This lime forms a chemical combination with the soluble arsenic and makes it insoluble. The insoluble arsenic kills the insect as readily as the soluble so that we gain a great deal in the addition of a little lime and lose nothing. By this means the arsenites may be used nearly double the usual strength on most foliage if thought necessary and still run no risk in injury to the leaves. On the very tender and susceptible peach foliage, they may be used in this way where they could not be before.

There is another combination with the arsenites that is meeting the popular approval of fruit growers because it combines a fungicide and an insecticide in one application. It is the Bordeaux mixture.

Its constituents are lime and copper sulphate so that the lime in it takes up the soluble arsenic as with the lime alone. It has long been used as an excellent remedy for leaf blights, moulds, rots, scabs, etc., of fruits and by using London purple or Paris green with this, the insect pests are killed at the same time.

The time has been when people were quite skeptical regarding the use of the arsenites, because of the danger in applying them, and also in the use of fruit and vegetables after the poisons had been used. I think that fear is largely disappearing.

Before we leave the arsenites, let us devote a moment to the insects for which the poisons are the best adapted. As the effect is produced by eating the poison we should expect all insects that eat the leaves would be destroyed by the poison on them and in general this is true. All caterpillars, such as the orchard canker worm, codling moth, bud worms, tent caterpillar, cabbage worm, tomato worm, tall web worm, army worm, cut worms, and oak caterpillar, are readily destroyed if the poison is applied on what they feed. All the plant feeding beetles, such as the potato beetle, May beetle, grape vine flea beetle, and plum curculio come in the same list. Then we may add the currant worm, rose slug, pear and cherry tree slug to the list. For a large per cent of these, the arsenites are

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our best and often our only remedy, while for quite a number of them I may be able to suggest some better remedy.

Spraying the apple orchard for the codling moth has become such a well-known and established factor in the raising of apples that it is hardly necessary to dwell upon that long, and yet I know of farmers today with good fruit bearing orchards who get little or no marketable fruit because their orchard is not protected from insect depredations.

Such fruit growers sacrifice their share of the profits to those who do spray their orchards, as they help maintain a good price for perfect apples. The first spraying should be about a week after the blossoms on the late trees fall. If this spraying is thorough and the rains following are not too heavy, the one spraying will save the greater share of the fruit. Otherwise a second spraying a week or two later will be necessary.

The canker worms, looping caterpillars about an inch long, that strip so many of our orchards in early spring, and the little bud worms that feed on the buds and unfolding leaves and the leaf rollers appear about the time or a little earlier than the codling moth and are also killed by this spraying, so that we make a general slaughter by the one application. The tent caterpillar that builds its tent in the crotch of some limb in the spring is perhaps more easily disposed of by cutting out the little branch and crushing or burning the occupants of the tent. The only means of using arsenic for the cut worms is by taking freshly cut clover, grass, or mullein and, after wetting it thoroughly with one of the arsenites, scatter through the infested field in little bunches. Some consider this method very successful while others place little value on it.

In the peach belt of New Jersey the growers now whitewash the trunks of their peach trees through the summer with lime in which has been mixed Paris Green. They say this kills the young borer as it commences to gnaw its way through the bark.

The use of the arsenites for the plum curculio has been a matter of considerable controversy and varied experience for some time, but it seems now to have settled down to about this conclusion: if the plums are plentiful and curculio not too numerous a good crop of plums will be harvested by spraying two or three times at intervals of about ten days or two weeks, beginning before or as soon as the blossoms fall; but, if on the other hand, the curculio are numerous and the plums scattering, the curculio will have them before they mature. By experiment we find it takes between two and three days for the curculio to die after it has eaten the poison, and this shows why the arsenites are not a better remedy and how many plums and cherries the curculio may sting while the poison is taking effect. There are a few other beetles, such as the rose chafer and turnip flea beetle, that the arsenites are even slower yet to act upon, and we must seek for some other remedy for them.

For the first appearance in the spring of the currant worm, I can recommend nothing better than the arsenites. The first brood appears soon after the currants blossom, and if the bushes are given a thorough spraying at this time, they will remain almost entirely free from the pest the remainder of the season. There is no danger in the use of the poison with the fruit so young, and they are plainly more effectual, certain and cheaper than hellebore, which should be used later if found necessary.

From what has already been said and from what you know in your own use of insecticides it is very evident that however good any one insecti-

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cide is, all insects will not be killed by it, and we must look for something else to assist us. Besides the exceptions already given and many others not spoken of, there is one whole order of insects that the arsenites have no effect on whatever, or only to a slight degree at least, and these are the true bugs, which live on the sap of plants and blood of animals. Perhaps the commoner of these are the entire class of what are known as stink bugs, such as the brown squash bug, tarnished plant bug and yellow-lined currant bug; also the little plant lice, or green fly, lice on stock, and ticks on sheep. An examination of the mouth parts of any of these insects would soon show them to have no jaws to chew with, but a slender beak which they insert and then draw the sap or blood through this beak into the stomach.

We now see that for this class of insects we must have something that will kill them by contact instead of internal poisoning, and the next few insecticides that are given will be some of this nature.

FIRST, KEROSENE EMULSION.

This has now become almost as well an established remedy as the arsenites. It is cheap, simple and effectual. It is made of soap, kerosene oil and water—three ingredients that the farmer always has at his command. The formula is, to two quarts of water add one quart of soft soap or one fourth pound of hard soap, and heat the whole to boiling. When the soap is dissolved take from the fire, add a pint of kerosene and agitate so thoroughly and rapidly with a force pump without the nozzle, that the mixture will foam like milk when filling a dairyman's pail on a summer's evening. It should be churned in this way until the soap and oil become permanently mixed; that is, until the oil will not rise or appear on standing or when diluted. This will take at least three minutes rapid work. Stirring with a stick or spoon, or slow pumping will not emulsify the soap and oil, though an egg beater may be used for a very small quantity. The emulsion as first made is too strong and will injure the plants unless diluted before applying. The soft soap emulsion should have as much water added as there is emulsion, and the hard soap emulsion twice its bulk of water added and well stirred. They are now ready to be applied with a spray pump. The dilute emulsion should be stirred frequently in applying.

The above is the regular formula. The emulsion can be made in larger quantities in the same proportion, but if made in quantities larger than six or eight times the regular formula, it will be difficult to make a stable emulsion with a small hand force pump. This has been one of the discouraging features in the uses of kerosene emulsion. It now seems evident that we can overcome that difficulty in a large measure. The method is to use the soft soap formula, as given above, leaving out the water. The soft soap is heated until it becomes liquid and then, without water, add half as much oil as there has been soap used, emulsifying according to the directions already given. The emulsion made in this way is as perfect as when made with water and is so concentrated that it is one-third oil, or in other words, the same emulsion in this way occupies less than one-half the space that it would when made by the first formula given. An emulsion made in this way without water will need to be diluted with four times its own bulk of water before using.

It was certainly owing to the improper emulsifying that led to the wool

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coming off his sheep as reported by Mr. Beck in the Michigan Farmer, Dec. 9, and in not recommending its use as long as the other dips could be used.

There is little question but that it will take the wool off if there is free oil on the surface, but if thoroughly emulsified and properly prepared there is no better and more effectual sheep dip used and it is much cheaper than the others too. (Mr. Sherwood has found this effectual on sheep scab.)

For lice on stock and hogs it is also an excellent treatment. Take a pail of the diluted emulsion and a scrub brush and in a very little while a stable full of live stock can have their coats thoroughly saturated. A thorough scrubbing of all the parts in this way will effectually free the stock of lice and produce a remarkably sleek, glossy coat and hide. Lousy hogs may be cornered in the pen and sprayed if thought best. As a last resort the emulsion may be used in ridding a badly infested chicken house of lice or mites.

For the little plant lice that throng so many of our plants and trees so early in the season, and the most of the plant bugs, about the only remedy that we have is the emulsion. It is also one of our best specifics for scales lice which we find attached to the bark of trees in scale-like manner, as the little apple tree bark louse. The oil in the emulsion will penetrate many of these scales and so reach the occupant inside. The emulsion is always more effectual if thrown with force on an insect as in a spray and should be used in this way always, if possible.

BUHACH AND PYRETHRUM.

These two substances form the second of the insecticides that kill by contact and are very valuable to us in many instances where the other insecticides can not be used. The two substances are made from the flowers of a plant closely related to the chrysanthemum and daisy. The dried flower heads are very finely ground and this powder makes our buhach, pyrethrum, dalmatian and Persian insect powder of commerce.

There is little difference between the buhach and pyrethrum except that they are from two different species of plants, and the buhach is manufactured in California while the pyrethrum is imported from Persia. The great advantage in the use of these two as an insecticide is that they are perfectly harmless to man and all animals which breathe by means of lungs. Insects have no lungs and breathe merely through little openings over the body, but just why it should have such a different effect on them is not known except that it manifestly acts on the nervous system. There is a volatile principle about the powder that readily escapes on standing and unless confined in nearly air tight vessels it soon becomes worthless. For this reason our buhach is decidedly preferable to the imported pyrethrum owing to its greater strength and freshness. Druggists usually keep one or both of the powders in stock, but as they are apt to lose their strength it is best to get a new supply each season, and if much is to be used you should insist on your druggist getting a fresh supply often or else ordering yourself direct from the Buhach Manufacturing Co. at Stockton, California. If a person buys some powder to use that is old and has lost part of its strength that person is apt to condemn the insecticide by this one trial as worthless and not to be recommended to others for any purpose.

The buhach may be used in three ways: as a dry powder, as a powder in

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water, and as an extract. It is usually used as a powder and applied by means of a hand bellows, or else shaken from a piece of muslin. Remember it must strike each individual insect as it kills only by contact. It is probable that the powder in water as a decoction is superior to the dry powder in applying to insects. If made in this way, about a tablespoonful should be used to each gallon of water (if hot water is used all the better) and applied with a spray pump. The extract is made by filtering the powder with kerosene or alcohol and then making an emulsion from this liquid and soap suds. In this way it combines the insecticide properties of the buhach and kerosene in one and makes a very powerful remedy, but is doubtful if it is enough better to advise its use, considering the extra work necessary to prepare it.

Whenever you have a soft bodied insect like a caterpillar or currant slug and for any reason cannot use the arsenites or kerosene emulsion, your best plan is to try the buhach in some form. Oftentimes when fruit is nearly ripe, neither of the above can be used for obvious reasons, but the buhach will be harmless and effectual. This same powder is an excellent remedy to rid the house of flies by getting them all into one room as nearly as possible at night and after closing the room tightly, blow a little of the powder over the room with a hand bellows and leave till the next morning. The flies may then be swept up and cremated so that none may return to life. I have had excellent results in using the same remedy on cockroaches. The powder is also a good remedy for insects on tender greenhouse plants.

The next insecticide we shall speak of is one that attacks the insect in the form of a gas and suffocates it.

BISULPHIDE OF CARBON.

It is a clear, nearly colorless liquid that changes to a gas as soon as exposed and quickly diffuses itself through the air. For this reason it must be closely confined in a nearly tight box, room or building to keep it where it is wanted to treat the insects. All insects that inhabit grain bins, granaries, grain elevators, grist mills and similar places are treated with bisulphide of carbon and no other remedy can anywhere near equal it.

The insects working in stored grain this season have been very common and we have received a great many letters asking for remedies. It is well to be on the lookout for these grain weevils, but let me add right here that nine times out of ten these grain beetles would not appear if the old grain had been entirely cleaned out and the bin swept before the new grain had been put in. Bins should always be thoroughly cleaned before filling with the next crop of grain.

One of the first signs of these minute beetles is the heating of the grain.

If any of the grain insects are found the quicker they are disposed of the better as they breed very fast and may soon cause great annoyance and do much harm to the grain. The amount of CS_2 to be used is about two pounds for each ton of grain. If the grain in the bin is not more than four feet deep the liquid can be poured over the grain and quickly covered as tightly as possible. The gas is so much heavier than air that it readily settles through the grain from the top permeating the whole with its noxious odor. There is no danger in pouring the CS_2 into boxes or bins of bran and other ground feed. The liquid will soon evaporate and leave no wet spot or hard lump. After treatment it is best to keep the bins closed for about two days before airing the grain. After being exposed to the air

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it takes but a short time for the odor and effects to entirely disappear. No injury is done to the grain neither for food nor for next years seed.

This insecticide is also used in killing the weevil in peas and beans at our large seed warehouses and may be used with as good results with our own seed when placed in a tight box or jar. Woodchucks are soon cleared from a field by saturating a piece of cotton batting with CS_2 letting it roll into the hole and then tightly stopping the opening to prevent the gas from escaping.

Ants with their unsightly hills on our lawns and in the meadow may be speedily dispensed with by making a hole in the hill with a bar and after a small quantity is poured into this hole stop it up with clay, or better, cover the whole hill with a wet blanket. After the blanket has been over the nest a few minutes, take it off and ignite the gas and see what follows.

The gas is very inflammable and great care and judgment should be shown in the use of it around buildings. No light should be used near the gas to ignite it, and no light should be used in the building until it is thoroughly aired.

CRUDE CARBOLIC ACID

has some very good insecticidal properties as a repellent to certain insects, probably owing to its peculiar odor. Mixed with strong soap suds, it makes an excellent wash for the trunks and limbs of trees, both for destroying scale lice and as a repellent to the various borers. The best time to apply the emulsion for these pests is in the early part of June.

The carbolic acid mixed in air slaked lime or plaster at the rate of a teacupful to each bushel is said by those who have tried it to work well in keeping the plum curculio from their trees. With others it has worked well in keeping the little striped cucumber beetle from cucumbers and squashes.

In the celery fields this season on the little celery negro bug we found it served as a repellent both in this form and by sprinkling water over the plants which contained a teaspoonful of the crude acid to each gallon of water.

HOT WATER.

This is one of our simplest yet one of the most effectual remedies that we have in a small way. Take a farmer with a few cabbages in his garden near the house and the hot water becomes about an ideal remedy. Heat a teakettle of water nearly to the boiling point, carry it to the garden and pour the water over the cabbages is all that is necessary. It costs nothing and takes little or no time. Insects are killed from 145 to 150 degrees Fahr. while the cabbage will endure water raised to 180 degrees. I find this is the only remedy that will kill the little negro bug on the celery and about the only remedy that will kill the rose chafer. We rather thought it would kill the big brown squash bug, but find the bug will endure the temperature to 165 degrees, while the squash is wilted at 160 degrees. We are still looking for a remedy.

TOBACCO DECOCTION.

Besides being used as a sheep dip and chicken louse destroyer this remedy is sometimes used with good effect on the little flea beetles that eat the minute holes in the leaves of turnips and radishes.

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WHITE HELLEBORE

is often used as a substitute for the arsenites and buhach as it both poisons by eating and kills by contact, but although it possesses properties of each in a milder form, it is inferior to them and is only occasionally used for such insects as the currant worm and rose and pear tree slug. Probably the best remedy for these slugs is lime or dry road dust thrown over the trees. The slugs are sticky and the dust will readily adhere to them

MECHANICAL MEANS.

Lastly but for many insects the cheapest and simplest means is by mechanical work of our own. No remedy can reach the currant borer as well as a sharp knife that cuts the affected shoot off so that it can be burned with the borer inside of it. It is quite doubtful whether we yet have a surer and safer remedy for the peach borer than digging it out. No remedy has yet been found that equals the tarred pan drawn over the meadow for catching locusts, grasshoppers, and leaf hoppers. Often a pan with a little kerosene in the bottom placed under a bush with insects on it and the insects jarred or shaken into the pan, is quicker and simpler than any remedy we can produce. With a good general knowledge of insects and insecticides, and the exercise of good judgment one will know what is his best course to pursue in combating any special insect pest.

THE SUGAR MAPLES OF CENTRAL MICHIGAN.

Acer barbatum Michx. *A. saccharinum* Wang.

BY W. J. BEAL.

[Read at the Brooklyn meeting of the American Association for the Advancement of Science, held August 15, 1894.]

Our most thorough student of trees says, "The sugar maple is the most variable of our species." * The following are some of the characters: The bark of trunks or limbs 2–30 cm. thick is gray to almost black, sometimes with white or very light spots 1–4 cm. wide, arranged irregularly. Owing to the expansion of the trunk with age, these light spots become elongated in the direction of the circumference of the tree. Certain patches are rendered white by the bleaching of the outer cells of the bark; the darker portions take their color mostly from the color of lichens or other fungi growing thereon. Some of these are almost black, many of them gray and some yellow. Along streams or on low land there seems to be a greater proportion of dark trunks than are found on drier land.

While young, the top is often narrowly ovoid to ovoid or even spherical or linear, but when older and grown in open spaces the top is most generally nearly spherical. There are numerous exceptions.

* C. S. Sargent, Garden and Forest, iv, 148.

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The branches at the close of the first season are orange brown, marked by pale oblong lenticels; at the close of the second year pale brown to gray tinged with red.

Buds were not studied.

The leaves are destitute of stipules; the petiole smooth or nearly so; the blades of lower leaves flat or sometimes drooping, thin, 5–7–9–lobed with rounded sinuses and acute sparingly sinuate-toothed lobes. The base is more or less heart-shaped by a broad or narrow sinus, or truncate or rarely slightly wedge-shaped, upper surface light or even dark green, opaque, the lower pale green to glaucous, sometimes tomentose on parts of the veins; diameter 8–19 cm.

The upper leaves are oftener three-lobed with longer spreading points, usually thicker and smaller, the upper surface dark, glossy, the margins slightly turned upwards, the base slightly cordate, truncate to obtusely wedge-shaped.

Inflorescense and flowers were not studied.

The fruit is glabrous, compressed-globoid; wings parallel or nearly parallel to diverging more or less, even at an angle of 95 degrees, each wing linear to almost spatulate, 13–25 mm. long, 5–13 mm. wide.

The wood was not studied.

BLACK SUGAR MAPLE.

A. barbatum var. *nigrum* Sargent. (*A. nigrum* Michx.)

The stipules are often, though by no means always present; petiole more or less pubescent, the base broader; blades rather larger, those on lower limbs, and sometimes on the upper also, often limp or with edges drooping, the sinuses usually broader, the lobes shorter and blunter, the base of leaf with the sinus often closed or with edges overlapping, the upper surface dark green, the lower dark green or yellowish green, usually clothed with short pubescence. The leaves on the upper branches are often, though not always, shaped like those of the species.

A. saccharum var. *barbatum* (Michx.) Trelease.

Numerous trees in Central Michigan bear leaves on the lower branches which are unmistakably those of the species, while those on the upper branches correspond to those as described by Trelease under the last name mentioned. I conclude, therefore, that this variety is not well established. The buds and flowers have not been thoroughly studied.

In Popular Gardening, Vol. 3, page 24, (1887), Pofessor L. H. Bailey defined by text and illustrations what he believed to be the true sugar maple and the true black maple. He referred to the trees of central Michigan and believed these two were distinct species. The following are the distinctive points he drew up to characterize *A. nigrum* Michx.

The trees about equally abundant.
The leaves usually large (6–8 inches across).
The leaves very much thicker (thinner, Sargent).
The leaves duller green.
The lobes fewer.
The lobes nearly blunt.
The sinuses broader.

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The sinuses shallower.
The sinuses at base of blade usually closed and the edges overlapping.
The under surface of blade and the petiole pubescent.
The blades limp or the sides drooping.
The stipules believed to be always present and caducous.
The fruit much smaller.
The fruit more divergent, though not constantly so.
The branches more upright and the top narrower.

Intermediate forms not detected, though hundreds of trees were observed.

Professor Sargent in Garden and Forest above quoted says: "Many intermediate forms occur which connect it with our common eastern sugar maple and make it impossible to look on the black maple as a species."

An examination of hundreds of herbarium specimens of maples from various parts of the country are not very likely to enable one to decide these questions satisfactorily, unless it is specified that the specimens were collected near the tops of bearing trees as well as from the lower branches.

I presume nearly all collectors would be satisfied with specimens procured from the lower limbs within easy reach. Having in view what others have said and done * by the free use of a ladder, with pruning knife on the tip of a long pole in the hands of a fearless climber, specimens have been taken in various portions of two or three townships from a good deal over one hundred sugar maple trees.

I will now attempt to verify the characters of sugar maple and its variety the black maple, as I have given them above, by referring to authentic numbered specimens.

By counting the trees by the roadside and in open places and on the campus of the Agricultural College where they grew with plenty of room, the proportion of black maple to the species is not far from three to eight.

Two trees from Blake's woods not far apart were selected because the bark was much of it black in color. In each case the samples here shown were taken from limbs about 4 cm. in diameter.

No. 6 is apparently *A. barbatum nigrum* Sarg.

No. 11 is apparently *A. barbatum* Michx.

The bark is colored by several kinds of lichens, and the black portion by several other fungi, and the two are essentially alike.

Nos. 27 and 30 are *A. barbatum* Michx. The bark of the former is gray to black, of the latter, black, with spots of white and dark green, to gray.

As an index of the shape of the top of the species and of the variety, all the trees on both sides of the road by the Peninsula farm were observed, forty-four in number. The trunks were ten to fifteen inches in diameter, rarely a little smaller.

The tops of the black maples were as follows:

Upright, 3; ovoid, 4; broadly ovoid, 2; much spreading, 3; total, 12.

The tops of the species were:

Very narrow, 1; upright, 11; ovoid, 12; broadly ovoid, 1; much spreading, 6; total, 31.

In these cases it would be hard to make a rule for the shape of the species that would not apply as well to the variety.

* Consult "Sugar Maples, and Maples in Winter" by William Trelease. Reprinted in advance from the fifth annual report of the Missouri Botanical Garden, Jan. 1, 1894.

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No numbers of *A. barbatum* that were seen have stipules. Numbers 2, 6, 8, 9, 13, 29, 35, 41, 42, 45, 53, 54, have stipules more or less apparent in some places; while number 14 has very small points; number 57, none. These I place under the variety. Numbers 42 and 44 seem to be doubtfully referred to the species or the variety. There are some very narrow and short stipules on the latter number. Others of the variety were seen with no stipules, even on thrifty twigs. The stipules seen on the trees above noted could hardly be called caducous, as they were well attached as late as July 20.

The base of the petiole of the black maple seems usually to be broader than that of the species, though there are exceptions on both sides. In number 53, some of the stipules are very large, and occasionally extended into slender petioles bearing small distinct blades.

The bases of some of the largest leaves of sixteen plants of black maple were measured after drying, and twenty-nine plants of the species. The measurements were taken around the lower side. An average of the largest of the species is 4.84 mm. with a minimum of about 4 mm. and a maximum of about 7 mm.

The average of the largest black is exactly 8 mm. with a minimum of about 6 mm. and a maximum of about 12 mm.

The lower surface of some leaves of twenty-two plants of the species were examined. In every instance there was more or less pubescence at the angles of the largest veins and their largest branches, while in numbers 17, 26, 30a the pubescence in the angles is considerable. On the blade away from large veins there was no pubescence. The lower surface at some leaves of sixteen plants of black maple were examined. In numbers 13, 44, 54, 57, the lower surface of the leaf was sparingly pubescent, while in others the pubescence was more abundant. In numbers 6, 35, there was some pubescence on the upper surface. The petioles were glabrous to strongly pubescent and these peculiarities did not always correspond with the lower surface of the blades.

The transverse diameter was taken of the largest leaves, measuring from tips of lobes of dry specimens. The average width of one leaf each of twenty-nine plants of the species was a little over 128 mm. with a minimum of 80 mm. and a maximum of 190 mm. The average width of sixteen of the black was 163 mm., with a minimum of 130 mm. and a maximum of 220 mm.

The number of lobes of large leaves of twenty-nine plants of the species averaged exactly 5, with a minimum of 3, and a maximum of 7, mostly 5. Sixteen of the black averaged 5.1, with a minimum of 3 and a maximum of 7, mostly 5.

The sinuses of the sides of the leaves of black maple are often shallower, especially those of the lower leaves, but in the upper the lobes are often long, slender, and acuminate. Leaves of number 49, evidently of the species, have the shallowest lobes of any seen, some of them much like those of *Menispermum*.

In numbers 15, 20, 27, of the species, the basal sinus is quite deep, while in one of number 16 the sinus is deep and the sides overlapping. The basal sinuses of numbers 2, 6, 9, 42, 44, are mostly open, while numbers 9a, 13, 14, have the lobes overlapping.

The slender tips of the lobes of the species are often twisted, notably numbers, 3, 10, 19, 43, 48, 56. The same is true of the black, as in numbers 2, 6, 8, 14, 29.

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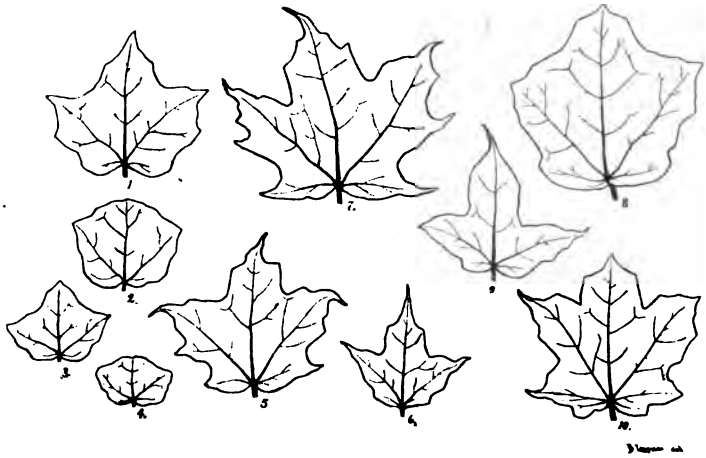

PLATE 1. Numbers 1, 2, 3, 4, 5, 6, 7, leaves of Sugar Maple. *Acer barbatum* Michx. Numbers 8, 9, 10, leaves of Black Sugar Maple. *Acer barbatum nigrum* Sargent; all about one-fifth of natural size.

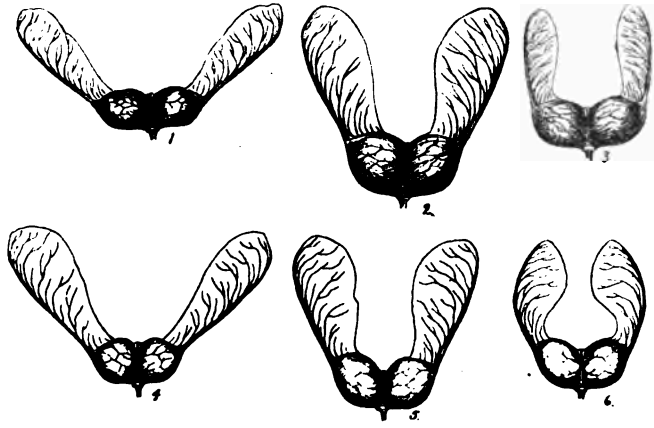

PLATE 2. Numbers 1, 2, 3, fruits of Sugar Maple; numbers 4, 5, 6, fruits of Black Sugar Maple; all about four-fifths of natural size.

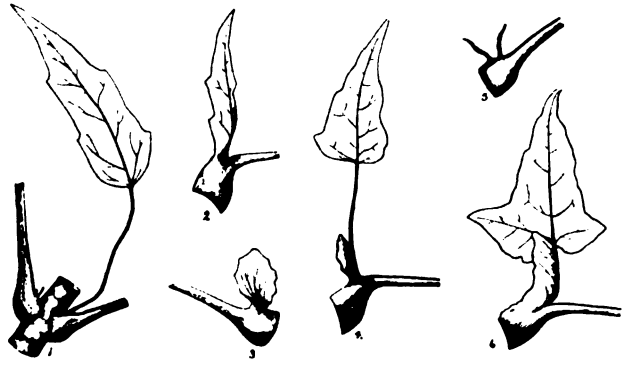

PLATE 3. Stipules of leaves of Black Sugar Maple, three-fourths of natural size.

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THE FARMERS' COLLEGE.

WHAT SHOULD IT BE? WHAT SHOULD IT DO?

[Paper read at the Battle Creek Farmers' Institute, Feb. 16, 1894, by Daniel Strange.]

The farmers of Michigan need not be told that by the Farmers' College we mean our Michigan State Agricultural College. What should it be? What should it do? Regarding the mission of other colleges in general there is little dispute. Excepting the question occasionally raised whether they ought not to teach more of science and less of classics, there is little contention or controversy regarding their sphere or mission.

Not so with our farmers' college. It is now 36 years since first its doors were opened, the first institution of its kind in America or in the world.

Just what it ought to do was a serious question for its founders, and since it began its work nearly every farmer or educator who has known aught of its work has made suggestions or contentions that it ought to do something more or something different. The mere enumeration of the reckless and fantastic notions of what it might, could and should do would require considerable time.

One criticism there is, however, so widespread and so oft repeated that it may well claim our attention. The form it takes is often this: The college educates young men as special scientists, but its graduates do not return to the farm practical farmers, skilled in all the finer mechanical operations, and excelling, in both plant and animal surgery, the experts already in the field. Let us light the torch of reason and look at this implied demand.

The physician sends his son to a medical college. Does he expect him to return at once more skilled than the specialist of many years' experience? Who would employ a lawyer's son just out of law school, expecting him to excel the lawyers of many years' experience? Is a man expected to be an eminent chemist, botanist, entomologist, astronomer or engineer immediately after leaving school, or only after years of laborious practice?

Is a man expected to be a skilled builder, or even butcher or baker, from what can be taught him in school, or only after years of practice in his vocation? And yet a graduate of our college is expected by some to be each or all of these.

The truth is, a thorough knowledge of the science of agriculture implies a large knowledge of every one of these sciences. No other science reaches out and lays hold of and demands a knowledge of so many related sciences. And little as we are aware of it, the practice of farming requires a skilled touch at every turn. And yet a gentleman who has spent his life in greenhouse work was lamenting a short time ago that his son, who had graduated at the college, was not as skilled in greenhouse work as was the father. He thought they had a greenhouse at the college and that students were all educated to manipulate it. Another is disappointed that his son is not skilled in all the varied arts of the dairy. Another would have his son a skilled orchardist, and many assume that each young man could and should be all of these.

Imagine that the college should attempt to do all this work and that young men should try to learn it. Two years, at least, the greenhouse

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takes. Add two full years at least to learn to grow small fruits, and two years more for garden truck, and five years more on top of these to learn to fight the insect pests, and still he's not expert. Three years will serve to learn to grow farm crops. Another year to learn to drain, a year to learn to drive a horse with skill, and ten full years to learn to breed live stock. An old man now, and naught is learned except to use his hands.

Granting that such a school could be maintained, no young man could ever wish to take the course. He might attend to learn to be expert in some one line. A school like this might be a training school but never could it be called a college. If young men seek only special training in these lines can they not find abundant opportunity to engage with well known experts? Would it be wise, at State expense, to keep a school for boys to learn what they could learn while hard at work with practiced men? Our college plainly cannot do this work. Granting that such a school should be maintained, it could not be a college.

A college still is needed. Hundreds of farmers' sons learn the manual art of farming well at home; they are imbued with a thirst for knowledge. They would know more of the things that are in the world, and of the things, persons and events that have been here. They desire especially a knowledge of those sciences closely related to their vocation. They can study chemistry at any college, but it is the chemistry of drugs and metals rather than the chemistry of earths, plants and foods. They can learn botany, but of the forest rather than the field. They can learn physiology, but not of domestic animals. They can learn geology, but not as related to soils and their productions. At other colleges the entire environment is such as to wean young men entirely from all taste for farming.

If farming is to be a noble profession, giving employment to the best of men, there must be that about it that can give food to the best of thought. If it is to be the vocation that brings man most directly in communion with his Creator he must be able to commune more closely by comprehending more fully the wonderful works of the Creator, and reading more readily from the marvelous book of nature as its leaves are daily unfolded before him.

If farmers are to rank with men of knowledge and influence they must themselves possess knowledge; and that systematized and at their command, as it can only be by culture. The intelligent, enterprising farmer should be able to give his son at least four of his best years in his teens for culture, that he may be more than a mere skilled mechanical manipulator. Beside being a skilled worker he should be capable of the largest, broadest, keenest thought. The intelligent and ambitious son does desire to spend a few years in broadening his knowledge and his understanding. The college plainly should train, not only the every day farmer plodding upon his farm, but it should train the ablest of them. The men who are to be at the front in our farmers' State and national assemblies; the men, if you please, who are to be our future governors require a knowledge of nature and philosophy, rather than of classics. What education should our foremost farmers have? This plainly our college ought to give.

He should know enough of geology and mineralogy to understand their relations to his own soil, and the soil of all the region where his interest may reach. In other schools geology is not taught with special reference to its bearing upon the farm. So too of chemistry. If he is not an analytical chemist with a laboratory of his own he should at least know enough of the science to understand the analyses published expressly for

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him. He should know the nature of common poisons and their antidotes. He should know enough of science to realize the absurdity of the thousand suggestions he often meets. Every farmer understands, if he is an expert in arithmetic he readily uses his knowledge. If his knowledge is limited. he is timid to use even what he has: so of all the natural sciences, the farmer cannot know too much of them.

Of botany and the Bible he should know enough to know whether "every seed bringeth forth after its kind," or whether oats sometimes turn to timothy, or wheat to chess. Many a farmer's son acquires his stock of information regarding horticulture, fruit culture, etc., at the farmers' college. Anatomy and physiology should be studied by every one; but the phases of these most essential for the farmer are not taught at other colleges. Veterinary science he would seek in vain in other colleges of the State. A knowledge of entomology is indispensable for the farmer and it is to be sought in vain in other colleges. Of astronomy one should learn enough so that when he is told certain operations should not be performed when "the sign is in the head," he may at once reply: "The sign of what is in the head of what?" And when told the "moon will change tomorrow," he may intelligently ask "How much did it change today?" .

Of mathematics the intelligent farmer cannot know too much. Neither can his intelligent son study too much. Every step advanced in this science strengthens his reasoning powers and helps him ever to distinguish between that which is proved and that which is merely asserted. Every student should learn enough of surveying and engineering to know when the surveying, draining and engineering of his own farm and neighboring highway are properly done; and if he is bright, interested and ambitious, if he becomes a professional surveyor or engineer it ought not to be set down against the college that he has learned too much.

An intelligent farmer ought to know enough of landscape gardening so that the yard around his own dwelling should not outrage all the laws of beauty known to science or art, and if a graduate should become a professional in his line, as some have done, it is better so than that 10,000 more farm homes should continue to shock all cultivated taste. The intelligent farmer should know enough of history to appreciate the frequent allusions in his daily reading. If he is to take his stand beside intelligent men he cannot afford to be ignorant here.

If he is to be a thinking man he must learn enough of logic to think correctly. Thousands of our farmers are thinking now, alas! too much, because, forsooth, they are thinking wrong. They should learn in youth the difference between a demonstration and a fallacy, between a syllogism and a sophism. Intelligent farmers should learn enough of rhetoric that when they have thought correctly they may be able to express their thoughts intelligently, systematically, forcibly, whether in the Grange, the State Legislature, or the United States Senate. The college bred farmer should be able to speak successfully in public even if he has little practice.

The college bred farmer should know enough of political economy to understand definitely what causes have contributed to the present depressed condition of agriculture. If the people were suddenly tortured by a plague, and in their frenzy were rushing for remedies which every educated physician knew could only result in increasing their sufferings, physicians should be able and ready to tell them of their error. If, at the present time half the farmers are organized to demand remedies for their financial distress, which every student of the philosophy or history of

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economics knows can only deepen that distress, every farmer who has spent four years at our college, and has kept himself abreast of current thought and progress, should be able to cry a halt, and to tell them of their error promptly, positively and pointedly. The perpetuity of our institutions depends upon the intelligence of our farmers.

With this round of study, with agricultural chemistry and field botany, with entomology, practical agriculture, stock breeding and veterinary practice taught as nowhere else, and with three hours' daily toil on the farm, the intelligent farmer's son may find his time wisely and well occupied for four brief years—even if in this time he does not acquire more than the manual dexterity of the Yankee pioneer at every farm process, from making butter and butchering beef to reconstructing sleds and harness; with hotbeds, greenhouses and electrical machinery to manipulate meantime.

But it is charged against the college that they educate special scientists, and even that Dr. Kedzie would rather send out an agricultural chemist than a farm laborer; that Dr. Beal would rather graduate a professor of botany than a market gardener; that Prof. Cook would rather see one of his graduates the director of an experiment station or editing a great agricultural paper, than to see him digging ditches. It is true there has been in the past 20 years such a demand for teachers in our newly-organized agricultural colleges, and for skilled agricultural scientists to organize our experiment stations, as we shall never know again. Our college being the oldest of its kind has naturally been looked to to furnish these men. She has furnished an army of them. To my mind, it would have been to her eternal shame if she could not have done so.

But it is charged that young men are drawn to our college who have no thought or intention of becoming farmers. This is true. Dr. Kedzie has a reputation wider than the continent, not only as an agricultural chemist, but as a superior teacher. If men who would follow mining or medicine find elementary chemistry taught here better than elsewhere, let us not lay it up against the college, or the Doctor, but let us take pride in the fact and herald it abroad. It may be that all the natural sciences are taught here better than elsewhere in the State. Let us congratulate our college, ourselves and our sons.

But it is argued that the college educates men away from the farm, and that after four years' study they are disinclined again to take up farm work. I personally know that this charge is false. I went there with no intention of becoming a farmer. At the end of four years I was fully determined to be a farmer. I personally know scores whose experience there has been the same. True, all do not become farmers, but a large per centage do.

Why do not more of them become farmers? For two reasons. 1st. Because they have no farms. 2d. Because farming is not remunerative. Any bright student who graduates there is equiped at once to earn a salary greater than the income from the best 400-acre farm in the State.

I know a graduate of our college who, more than a score of years ago, was offered a salary of $1,500 to quit the farm. He declined, and has remained upon the farm. I never knew a more industrious man. He has not one expensive habit, except to support the gospel. He has greatly improved the productiveness of his farm, but has not increased his wealth. At the present rate of progress he cannot add $1,500 to his accumulations in as many years.

I know another who, by personal application to business, without one

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dollar invested, has made over $10,000 in a year. Nevertheless, because of his acquired love for the farm he has quit his former business and is now upon his farm, where his yearly acquisition cannot possibly be one-tenth of this sum. I know another who has filled one of the most important professorships in the State, has had a salary of $6,000 per annum, and yet, because of his love for farming, he is now upon his farm, where his usefulness to himself, to the State, or to agriculture, cannot be one-hundredth part of what it was in his former position. No; if the college is at fault in this matter, it is that it teaches too great love for the farm, and leads its students thus to sacrifice their lives which might be given, not to nobler, not to better, but to larger fields of usefulness. But whatever may be his vocation, the farmer's son who has spent four years within the walls of our college, acquiring such culture as she gives, associated with the nobler band of men who form her faculty, imbibing her spirit of love for truth and thirst for knowledge, cannot but be a nobler, broader man, and a more useful citizen, with a greater love for all mankind. The farmers' college then should be an educator. It should do as it has done, and as we trust it may long continue to do. It should send forth from its halls educated men.

DAIRYING.

BY A. J. BRACELIN.

[Read at the Allegan Institute, January, 1894.]

Whenever men invest labor or capital in an enterprise, they expect to reap reward. Our fathers cut down the primitive forests, and as a means of providing for their families a piece of rye or wheat was sown. As more land was cleared, more grain was sown, until sufficient was raised to make one or more loads, which were drawn many miles to market. I remember very well when my father drove a slow yoke of oxen, loaded with a few bushels of potatoes, some corn, and perhaps a few hundred weight of flour made from wheat that he had pounded out with a flail, through to the colony—now Holland—to sell to those sturdy Hollanders, the trip requiring about a week's time. This system of raising and selling grain continued for many years as more land became cleared. At length a few sheep were kept, and flannels and stockings were manufactured for the family. Gradually a few cows were obtained, and for many years the income from the farm consisted of a few lambs, perhaps a few fleeces of wool, more than was needed for home manufacture, a few pounds of butter per cow, which was taken at our village store in exchange for groceries, and a greater or less amount of grain, as the case might be, and exchanged for leather, salt, clothing, etc. This grain-raising has continued in this locality until much of the fertility in the virgin soil has been sold off in the form of wheat, barley, oats and rye: and yet we are not fully aroused to the large amount of fertility removed from the soil when grain crops are sold.

According to the New York experiment station at Geneva, I find when I sell a ton of clover hay that I remove fertilizing elements from my soil to

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the value of $8.20: oats, $8.17; mixed hay, $6.99; timothy hay, $5.48; wheat, $7.09; cheese, $20.83; while in selling a ton of butter I remove only forty-eight cents worth of fertility. If I am correctly informed, when crops are sold off from year to year the soil grows poorer, notwithstanding more or less manures are used; and there are plenty of cases where farms have become exhausted from this selling off process. On the other hand, some of these farms have been brought back to a high state of fertility by judicious and liberal feeding of live stock on them. I believe at this time there is no better way of increasing the fertility of our farms, and at the same time shying a stray shekel into our pocket, than by keeping cows and selling their butter product. One of the great advantages in milking cows and selling butter or cream, or milk, where the skimmed milk is returned again to the farm, is that it is a cash business. This is an advantage that is especially felt during times like the present, when money is close and hard to get. The farmer who keeps cows and sells milk to the creamery draws his pay at the end of every month. If he makes butter at home and supplies private customers the money usually comes in once a week. The farmer with cash to pay can buy groceries and clothing cheaper than one who has not. The store keepers always exacts heavy interest for carrying their farmer customers from spring until fall, at which time the grain-raising farmer can draw his crop of wheat to market, obtain fifty or fifty-five cents per bushel, and, if he has enough wheat to sell, can pay the current expenses of the season, for which he is then generally in debt, and be considered a lucky man.

There are a great many farmers casting around now in search of something else to engage in besides raising grain to sell. When these men once adopt better methods by which their land shall become yearly more fertile, I am sure they will not be contented with keeping inferior stock; and if one decides to engage in dairying somewhat as a specialty he will be satisfied with nothing but good cows. Now, the question naturally suggests itself to such a man, "Which is the best cow or breed of dairy cows?" I will describe the best cow and see if we can locate her in any of the dairy breeds. She is strong, with a deep flank, indicating constitutional vigor; her udder is right in form; her teats large and set wide apart; she is highly nervous, though a gentle animal; she is a deep milker, and the flow continuous nearly or quite the year round; she is not always the one that makes the most butter in a week, but she has the "faculty of hanging to her milk, which is rich in butter fats, for a period long enough to show that it is a characteristic fixed in her and her breed." It is quite needless to say, too, that she can be fed a heavy butter ration and carry only a reasonable amount of flesh, which she will always do. As secondary points, she has a slim tail and neck, and large escutcheon. Such cows are not ideal, and can be found the most readily among Jerseys. I do not claim that all Jersey cows are such as I have described, nor that all such cows are found only in that breed; but I do claim that a greater percentage of such cows are Jerseys than any other breed. The World's Fair has done much to settle this question of breeds. Out of a dozen or more that were there not more than four or five were worth attention.

The Jersey at home has been bred in her purity, assisted by stringent laws which prohibited other cattle from the island, for more than two hundred years, so that with the best of care and the production of butter as the objective, it is not surprising that she should acquit herself at the World's Fair tests as the best dairy cow on earth. The best and cheapest

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way to obtain such cows is to raise them, if one has the foundation stock and patience and ability to do so. The haphazard methods prevalent now in breeding, however, must be relegated to the past. The situation at present is one within the grasp of any thoughtful, observing man. There is no royal road in breeding dairy cows. The laws of nature are the same always, and dairy cows bred to dairy sires will produce dairy cows. You can not get something for nothing. You can not get a draft horse from a Shetland pony, nor a trotter from a plow horse, nor a dairy cow from a beef sire. You must breed to dairy sires all the time. With a herd of pure-bred Jersey cows the success or failure is largely due to the care its possessor bestows upon it. Pampered and humored in every whim at home, as one of the family, for so long a period, and the worshipped pets of millionaires in this country, the Jersey has had her hustling qualities destroyed rather than developed; so she is quite apt to lie down and wait for her food to be brought her.

So the man who expects his pure-bred Jersey cow to gather food in summer from a close pasture consisting largely of weeds and brush, and in winter to stand out at a straw stack with mercury close to zero, and do well, even so well as his scrubs, makes a grievous error. She will degenerate into a most worthless scrub if her care is sufficiently poor, and her owner will always condemn her and tell you that Jerseys are a failure and not so good as scrubs.

To proper care and management there is no cow that responds so nicely, proving herself a source of joy and a mint of wealth to her possessor. It is not necessary that her surroundings be costly, although no cow is more accustomed to such. But it is necessary that they be warm, clean, and dry in winter, and clean, airy, and dry in summer. She should be groomed daily, not only to promote health but to secure greater cleanliness. Filth should never accumulate on her. She should have an abundance of good food and pure water at all times, and if you are not on the best of terms with her, get there in the least possible time, for she will not do her best as a dairy cow if she works under protest. The practical dairyman keeps his herd for the profit there is in it, not for the "glory he may attain by having cows that give a pile of butter." I am aware the latter can not be attained without liberal feeding, but I am also aware that it may be so wasteful that it ceases to be profitable.

If my observation has taught me anything it is this: that "there is a limit up to which a cow profitably assimilates food, and when you try to force her beyond that capacity the ratio of cost to production is so increased that economic production ceases." Somé one has said that somewhere in its make-up every animal contains one of the most correct and reliable time pieces to be found. I will not vouch for the truthfulness of this statement, but I do know that it pays to be regular in feeding and watering as well as in milking.

In milking and handling the milk of the dairy I would have engraved on every board, or, better still, on the minds of every one connected with it, the word cleanliness. There is such a lack of this in our private dairies that I quote the utterance of a professor in one of the leading colleges in the country to the effect that for years the poor people of New York have been eating poor and rancid butter. Good butter, he declares, is obtainable in very few places. Those who can afford to pay forty, fifty, or seventy-five cents per pound can secure choice butter, made of good cream in a cleanly manner, but very few in a community can afford such a lux-

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ury. The others have had to take the butter from the ordinary dairies, which are filthy in the extreme. The cows stand in dirt up to their knees, and are milked by dirty men whose hands are seldom washed. Then the milk is churned by persons of equally dirty habits and the result is a butter in which are many substances that are neither appetizing nor wholesome. There would be little in this to concern any one but the parties that make such butter, were it not for the fact that this class is so large, as anyone conversant with the butter market must know, that it becomes a matter of no little agricultural significance. The present condition of affairs works to the advantage of careful and intelligent butter makers who find a large demand for their churn's product at satisfactory prices, but these men are not the sort to wish this condition to continue because they are peculiarly benefited by it. We need a wide spreading of the most intelligent dairy information, and this labor must rest largely on the agricultural press of the country, and on the farmers' institutes and similar meetings, for, unfortunately, the great body of poor butter makers do not reach out voluntarily for information, but it is necessary to press it upon them.

That an African darkness prevails over the minds of many farmers and keepers of small dairies must be quite apparent to any one who has given the subject any attention or thought. There is a deep prejudice—in cases almost a hatred—occasioned by the densest ignorance, against improved dairy stock and its product. One of these men, who was a little better dressed and who assumed an air of superior intelligence over his fellow workers in a gravel pit, a short time since, declared that he had always despised Jerseys, but thought less of them now since they had acquitted themselves so poorly at the World's Fair. It is well known by every reader that the Jerseys were awarded first place everywhere in the dairy department. This same man, to my certain knowledge, has never kept any but the poorest scrub cows, and his cows grow poorer the longer he keeps them.

Good butter, as good as any one desires, is easily made if one will quickly learn, remember, and practice a few important points. To begin with, good cows, preferably Jerseys, well fed and kept clean, are the essentials in the stables. Next, and not more important, is control of the temperature of the milk. This can be secured in hot weather by either naturally very cold water or water made so by the use of ice. The milk should be quickly cooled to 50 degrees in summer and set in shallow pans. With the animal heat of the milk thoroughly dissipated, I am confident deep setting is preferable, but with the animal heat left in, one gets fewer bad results from it by using shallow pans. The cream should be taken off as soon, at least, as the milk commences to sour on the bottom of the pans, and this generally occurs in summer in from fifteen to twenty-four hours.

Milk should not stand longer, as the cream is likely to become bitter. Cream, before churning, should be ripe—not sour—and a thermometer should be used to regulate the temperature, which will range from 58 degrees in hot weather, 60 or 64 degrees in cold. It should come in from forty minutes to an hour, though good butter is often obtained when it takes longer time. It should always be of good grain and consistency. To make best butter, a churn should be used without dash or paddle; and stop when the butter is in the granular stage. Now, draw off the buttermilk and thoroughly rinse with clear, cold water until it shows no color of milk, and your butter is ready for the salt, and will require no working except

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to mix the salt, which you can do with the churn if it is the rectangular or the over-end barrel.

Whether one is to make butter at home in preference to having his cream made up at a creamery, depends largely on the kind of help he has in the house, and on his own ability to dispose of it. Unless those who have charge of the milk after it is brought in are scrupulously clean and attend to every detail, he will not have a good article to sell, and unless he has the tact and ability to obtain remunerative prices he will fail, as good butter can not be sold in competition with poor. But with everything right and a good market he can not help being successful; and I wish to go on record here to the extent that I am a believer in the profitableness of dairying, and that it will remain to the man who will give the dairy that attention which will insure a first-class article of butter; and that the fertility of the farm can be easily maintained in that way.

COMMERCIAL POTATO GROWING IN OCEANA COUNTY.

BY JUDGE F. J. RUSSELL.

[Read at Farmers' Institute at Shelby, Mich., December 13, 1893.]

Ladies and Gentlemen—The subject assigned me I consider one of the most important to the farmers of this county, of any that could have been suggested. It effects not only every farmer and all in business within the country, but its effects are felt through the arteries of trade outside as much or more than any one industry of our people. This county is especially well adapted to the growing of potatoes, both by soil and climate, and that fact brings hundreds of thousands of dollars to our people yearly.

In the early history of the county, and especially was this true in the first crops raised on the land after its being cleared, the potato grew spontaneously. The new settler reached his farm during the winter or early spring; the first act was to fell the trees, to protect the log house that was to be erected, and almost the next that demanded attention was the planting of potatoes on the unplowed land amongst the logs; this was accomplished by digging through the leaves to the ground, dropping the potatoes, and hilling them up when planted, with leaves, leaks, and earth indiscriminately mixed, making a hill six or eight inches in height, which were often not visited after planting until digging time. If that time did not happen to come in the fall, we did it the next spring, and were as sure to find a good crop as we were to plant. At that time the potato was considered the worst weed that the farmer had to contend with, remaining in the ground and growing year after year—no scab, no blight, no potato bugs, nothing to annoy or hinder the farmer even with poor facilities from an abundant crop of large, smooth, first-class potatoes. With the increase of facilities, and the working of large, well cultivated fields and farms, these things have changed: whether that change has been to the detriment of the really practical farmer may be questioned.

A very important step toward a good crop of potatoes is proper soil,

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properly prepared. A good soil for potatoes in my judgment takes a wide range from quite heavy clay to quite a thin sand. I consider the best soil for a series of years from a clay loam to a heavy black sand. It is not uncommon that we have better results with more sandy land, and occasionally with more perfect clay: therefore in my judgment, no farmer in this county that has a farm worth calling such, has a right to abandon potato growing as his main farm crop from the fact that his soil is not adapted for that purpose.

I think it much better to plow the land in the fall before spring planting. I would prefer a clover sod to June grass or timothy; neither of them are indispensable to a good crop. The ground should be well plowed in the fall for the reason that it can be done cheaper then, and holds the moisture during the next summer much better, than if plowed in the spring just before planting. If you cannot plow in the fall, do so as early in the spring as possible, before the top of the soil becomes dried. Drag and cultivate the ground after plowing, and before planting in the spring, the more the better. Cultivation can be done cheaper then, than after planting. The man who raises the most and best potatoes for the least expense solves the question of raising potatoes for commercial purposes. The planting may be done from early spring until June 25 with a fair hope of a good crop. My own judgment is, that in planting potatoes for commercial purposes in Oceana county it is best to plant between June 10 and 20.

I would never plant when the soil was unfit, even though I waited until July first. If the ground is too wet, and out of condition delay as long as possible, and if it becomes hard cultivate it again.

It is important that the seed be properly cared for in the spring. Store it in a shed where there is plenty of light, if the sun shines on it all the better. If piled it should be thin enough so that it will not heat. If the potatoes become sunburnt and do not sprout before planting, they are just right. They will then grow quicker with better stalks; those large green eyes, the size of the end of a lead pencil, waiting for a good seed bed, are what we want.

As to the size of potatoes best for seed, I have been inclined to those just under medium size, cut into two to four pieces according to size, with two good eyes on each piece. I have seen no bad results from planting small potatoes, from the mere fact that they were small. At this time I would not desire to plant small ones, unless I was sure that they were not made so by blight; I think that either scabby or blighted potatoes are very apt to reproduce those diseases. In planting small potatoes we are more apt to get a large proportion of that class, than if larger seed was used.

I would plant in rows three feet apart each way. For marking I use a sled with four runners made for the purpose out of two-inch planks, the outside runner fastened to the next with strap hinges, so that they may be folded up, using the bob sleigh pole for a tongue, with two horses to draw it. Mark the ground both ways, or one with this, as you prefer; furrow for the potatoes from three to four inches deep; we use one horse, and a Planet Junior cultivator with a broad shovel behind for that purpose. A one shovel plow can be used as well. Cross the markings if only furrowed one way. Furrow three rows across each end of the field for convenience in dropping, and covering; drop one piece where the marks cross, walking lengthwise of the furrow stepping on each piece as dropped. If this is not done the pieces are liable to become misplaced in covering. I cover with

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a Planet Junior with the side wings attached, and other teeth removed using one horse, walking lengthwise of the furrow. If you are not provided with this tool to cover with, take two planks, hard wood is best about twelve inches wide, one and one-half inches thick, and about three feet long, chamfer each plank on one edge, set the planks up chamfered edge down V shaped, the closer ends about ten inches apart, the other about two feet; nail boards over the top. If you have a two-inch auger put a pin through the planks near the top, making it good and strong. On the top of the wide end fasten two feet of 2x4, to it attach a hook to fasten a whiffletree; on the narrow end attach two plow handles, or even a straight stick to steer it with; use one horse, and drive him in the furrow drawing your machine broad end ahead. If it does not cover deep enough put on a stone. If your land is stumpy, one man can take two rows, and follow, covering the few that may remain uncovered. It is not a question of how many you can cover; it is a questoin of how many you can drop to cover; no person can afford to cover potatoes with a hoe in these days. The covering should follow the planting closely. The furrow will become dry, or the sun may burn the potatoes and ruin their growth. If the ground is very dry or wet and you fear trouble about your seed growing plant whole potatoes. If your seed is to be cut long before use, store it in crates, or sprinkle plaster over it, as freshly cut. If the soil is very dry after planting, and the seed is deep enough, you can assist in producing moisture by dragging with a light spike tooth harrow, crosswise or cornerwise of the furrow; they may be harrowed with profit until the vines are two inches in height. You will tear off some sprouts, but remember that you are hoeing the balance. I prefer as soon as the vines are through the ground, to go through lengthwise of the rows with a Planet Junior with the wings on, and cover the vines entirely up. If you have planted the potatoes properly in rows, once in a row will be sufficient; care in planting will save considerable labor. By covering in this manner cultivation may be commenced earlier, the weeds are killed about the stems, and the bugs are retarded. When the vines again appear they will be two inches in height while you sleep. As soon as the old bugs appear, I prefer to poison at once with Paris green and plaster, mixed one pound of Paris green to one hundred and fifty pounds of plaster.

Potatoes should be cultivated at least once a week, with a Planet Junior or other implement giving shallow cultivation, receding from the vines as they mature. After every rain, especially if the ground is not thoroughly wet be sure and cultivate. Do not allow your grounds to crust over; mellow and finely pulverized earth often moved on the surface, seems to act as a mulch, and not only that, it seems to have an attractive force, thereby lifting the moisture from below nearer the surface. If cultivation is continued weekly the vines will not be injured because of moving the earth in hot weather. If cultivation is suspended for a long time, the vines may be ruined in hot, dry weather. They had under those circumstances best be left alone until after a rain. I prefer to give my potatoes level, clean cultivation. If the ground is very wet, I prefer to hill with a single shovel plow. In caring for potatoes do not allow the weeds to grow; they are killed much cheaper when very small. You cannot afford to have them sap the ground, neither can you stand the expense of digging with the rows filled with weeds.

The question of killing or avoiding the potato bug in commercial potato growing, is an important item. I use Paris green mixed with land plaster

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for that purpose. I usually draw my plaster in old barrels near one edge of the field where they can be handily covered with boards, and two or more weeks before wanted for use. Take a box with a tight bottom, two feet wide, and four to six feet long, with eight inch sides; place it on the level ground, and measure the plaster and Paris green, and thoroughly mix with a hoe, and when mixed return to the barrels to await time for use. For old bugs I use one pound of Paris green to one hundred and fifty pounds of plaster. For young bugs, one pound of Paris green to three hundred pounds of plaster. If well mixed long in advance of use, one pound of Paris green with four hundred pounds of plaster will do. Mixing long in advance of use seems to add to the benefits derived when used. When desired for use I roll a barrel on the stoneboat and draw it to a convenient place along the edge of the field. I apply it by getting at the grocery light wood boxes six by eight inches, used for spices, remove the top and bottom, and tack wire door screening over the bottom for a sieve, tack wood or tin in a bow over the top to the sides making a stiff handle, and you can apply at will from one grain to a handful of plaster. It is better to apply plaster when the vines are wet with dew. This cannot well be done in large fields; we do not delay for want of dew, or on account of dry weather. We are occasionally compelled to suspend on account of a heavy wind.

The time to kill potato bugs is as soon as you have them. The first thing that a young potato bug does after he is hatched, is to go to the top of the vine around the small center leaves to see whether you have put Paris green there for him, and he should not be disappointed. There is the place to put it, and the time to use it is as soon as he arrives. If he is disappointed in finding it upon his arrival, he soon becomes discontented and begins to wander. If you wait until then it may be difficult to kill every bug at once. There is no sense in allowing potatoes to be eaten up by bugs. If you do, you need not expect a crop of potatoes, for if you do, you will be disappointed.

I am of the opinion that flour might be used in the place of plaster for mixing with Paris green. I hear of its being used with very satisfactory results. It is claimed when applied the first dew makes a paste of it, and that it will remain even through a heavy rain. I have used shorts with good results. Whether it might be cheaper than plaster to be used in large quantities, I cannot say. I have been informed that flour is cheaper from the fact that one application may be sufficient. I do not think that any one can afford to use water and Paris green to kill potato bugs. It is too dangerous to vines in being allowed to settle, one part of the same pailful will not kill the bugs, and the other part may kill the bugs and vines as well. The expense of killing potato bugs if properly attended to is very small.

I am unable for want of sufficient knowledge to say much on the question of potato scab. I am of the opinion that the older varieties that seem to be most affected, perhaps in part by degeneration, may with profit be abandoned for some of the newer and more vigorous kinds, which thus far are not much affected. It has been my experience as long as I can remember, that when a good potato has come from the originator, for the first years it is most satisfactory, and they have gradually degenerated until the kind has become extinct. Whether the fact that scab may be inbred in some of the older varieties is a potent factor in the development of it, I am not able to state, but am of the opinion that it may be.

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As to the cause of the potato blight I can give no information. I consider it perhaps the worst enemy of the potato grower in this county at the present time. It seems to come whenever or wherever it pleases. Its touch is death to the potato and disappointment to the grower. I am now well satisfied that if this year's crop of potatoes is badly blighted that seed planted from those blighted potatoes will probably reproduce a blighted crop. In this I may be mistaken; many potato fields that are not generally blighted have here and there hills that are struck. They do not ripen evenly as some say. These hills produce potatoes, and if small potatoes are planted these form a part of the seed, and by that means, if I am correct, the disease is inbred so to speak. I have had my potatoes struck with blight for the last two years; they were late Hebrons. The first appearance that I have noticed has been the blackening of the ends and outer edges of the leaves. If badly injured the vines from that time seem to decrease in size until they become black. I was informed by a man who noticed that his crop was affected, who at once sprayed a part of his vines with Bordeaux mixture, that the part so sprayed produced a much better crop than those unsprayed.

I prefer to plant late; by it you can usually avoid a part of the excessive dry weather and bugs and secure more benefit from fall rains with less scab, less blight, less cultivation and much more money.

If you fear that your potatoes are not fully ripe, and may be injured in digging by the skin pealing, allow them to stand two or three weeks after frost before digging; you will obtain some growth and they will ripen. I have never seen a potato digger that I considered worth using; too much loss and expense for the advantages derived; I want my potatoes dug with a hoe or fork. By that means you will get what potatoes you raise.

I prefer to scatter my crates direct from the wagon, dig the potatoes, and pick the large ones into crates, allowing them to stand wherever they are filled; then pick the small ones, doing the same. If the potatoes are to be sold direct from the fields, load the crates from where they stand to the wagon for market. If they are to be stored for winter load the filled crates to the wagon, and draw to a hole that has been prepared a foot deep and about six feet wide, continuing the whole as required, putting all the large potatoes in one hole. I use a few bundles of stalks to cover the potatoes during the nights while digging, until a part of the hole is filled, when we put a good quantity of straw on commencing at the completed end to cover, covering with four inches of earth from day to day until all are dug and covered. When the hole is to be covered for the winter add another good coating of straw, on top of the earth, and cover all with at least a foot more earth. By this method potatoes can be harvested and stored cheaper than when put in small holes, and can be taken out and to market cheaper.

I do not think that any farmer can afford to handle a large quantity of potatoes without bushel crates; they can be used for potatoes, apples and corn.

It will cost eight dollars and eighty cents on an average to raise an acre of potatoes in first-class shape without digging, without paying for the use of the ground, taxes and insurance; figuring the use and keep of a horse team at one dollar and twenty-five cents per day, and a man one dollar per day including board, which is about the cost of labor by the month on a farm. That amount is made up of the following items, viz.:

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Plowing sod	$1	50
Harrowing three times		67½
Marking		07½
Furrowing		23
Seed six bushels at 40 cents	2	40
Cutting six bushel seed at 4 cents		24
Dropping		45
Covering		23
Cultivating each way twice in each row		89
Cultivating three times each way once in a row	1	32
Purchase price of plaster		25
Paris green		07
Drawing plaster from the depot to field and mixing		07
Plastering twice		40
Total expense to raise one acre without digging	$8	80

If the potatoes are sold direct from the field, within three miles from depot, they can be dug and marketed for six cents per bushel. If they are to be stored, it will cost about five cents per bushel to dig and cover for winter, and three and one-half cents per bushel to cover and market afterwards. With an average crop of one hundred bushels per acre, within three miles of market, potatoes can be raised and marketed for fifteen cents per bushel. Some good crops are raised at much less cost than my estimate.

SHORT HORN CATTLE.

BY AMOS F. WOOD OF MASON.

What shall breeders do with their short horns? I would say take care of them and by care and judicious selection help them to fill any place suitable for the bovine race. The products of the country must change according to the wants of the people, and what there is a demand for at one time may not be wanted at another time. There has been a good demand for cattle to sell for breeding purposes, but when one has been passing through a depression of times like the past few years, and one cannot sell good cattle as breeders then see to it that you have a general purpose animal that can give milk for butter or cheese or turn the same amount of food into beef. Oftentimes good cattle pay to raise when poor ones will not and many do not realize the difference. According to recent statistics gathered in Ellisburg, Jefferson county, N. Y., where dairying is one of the principal products, only about 10 per cent of the cows paid a profit to their owners; why do they keep such cows? because many times they are ignorant of the fact and do not know how to make the change. It is no more than we are doing in raising wheat or producing a class of sheep for the product of wool. I have great faith in the short horns as the general purpose cattle and believe there are many breeders of whom the same might be said as an eminent breeder said of Thomas Bates. "You can keep on breeding short horns because they pay you in milk,

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butter and beef." Good steers are paying to raise and cows that will make 300 pounds of butter a year are not in debt for their keeping. The trouble with too many breeders has been keeping everything that was eligible to register regardless of qualifications to return profit to the owner. Had the short horn breeders been as careful in the selection of their herds for milk and butter which I believe might have been done without taking any merits from them as beef producers for the past 20 years as the breeders of Jerseys have been, I believe the result of the dairy test at the Columbian exposition would have been different. The breeders of Jerseys have for a number of years turned their attention to see how much butter could be made, and when a sire was a success in producing cows that excelled in milk and butter he was retained. One of the first things for the breeders of short horns to do with their cattle is to test their cows and weed out the poorest; they should bring for beef what they have cost, then be careful about the sires, select bulls from only well bred cows that when fresh in spring of the year will give not less than 40 pounds of milk a day on grass food alone, and will test at least 4 per cent butter fat, remembering that the greater quantity of good quality of milk, increases the profits.

To pursue the above course the heifers would fill the vacancies in the herd; the cow that paid the least would go to the shambles. If you have a bull calf from a superior cow that is a good individual, some one will want him for a sire, but upon the majority of male calves use the knife and have some first class steers that will pay in times like these.

In conclusion let me repeat, first, test your cows whenever a surplus, dispose of the poorest to the butcher. Do not sell them as breeders. Second, select only bulls from cows of known excellence. Third, remember the best will pay, and that there is no breed for the expense upon the good farming lands of Michigan that will yield as good a profit in milk, butter and beef as the short horns. Long may they live.

Mr. Gillespie endorsed the paper and the short horns for a general purpose cattle; the Jerseys have their good qualities and the Holsteins as well, but for all around cattle the nearer we keep to the short horns the better.

Mr. Butler while feeling friendly toward the short horns was in doubt about the profit of a general purpose cow. We want a cow for milk and butter. We can't compete with the west in raising beef. He believed that the Jerseys would put our products into butter to a greater profit than any other breed. Would have heifers come in say at two years and keep them in milk for a long season the first time.

Mr. Bateman thought nearly or quite as much depended upon the milker as upon the food or the breed. Not more than one in ten was a good milker. He was the one in their neighborhood.

Mr. Webb favored grade cows for profit. Had tried the full blood short horns, but was not satisfied with the results.

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STATE ASSOCIATION OF FARMERS' CLUBS.

DELEGATES FROM THE VARIOUS FARMERS' CLUBS OF THE STATE MET AT THE CAPITOL LANSING, FEBRUARY 1 1894.

The convention was called to order by A. C. Bird, of the Highland and Hartland Club, at 3 p. m. Upon motion A. C. Bird was elected temporary chairman, and L. H. Ives, of the Ingham County Club, temporary secretary. After considerable discussion it was unanimously voted to proceed to the organization of a State association.

Upon motion the chairman appointed a committee on constitution and by-laws, consisting of William Ball, Livingston; A. N. Kimmis, Oakland; E. L. Lockwood, Monroe, and C. E. Clark, Genesee; and a committee on permanent organization and order of business consisting of A. Templeton, Ingham; B. F. Peckham, Jackson, and F. M. Shepard, Shiawassee.

It was voted that members of farmers' clubs present belonging to clubs not otherwise represented be allowed to represent their respective clubs.

The convention then had the pleasure of listening to speeches by President Gorton, Profs. Kedzie and Smith, and Secretary Butterfield of the Agricultural College, Robt. Gibbons, of the Farmer, and others.

The convention having been invited to visit the college in a body and see the dairy school in operation unanimously voted to devote the forenoon of February 2 to this visit.

The committee on permanent organization then reported, recommending that the temporary officers be made permanent and providing an order of business. Report adopted.

EVENING SESSION.

Address of welcome—Mayor A. O. Bement; response, B. F. Peckham.

The committee on constitution and by-laws, not being ready to report, an hour was given to the discussion of the different methods of work of the various clubs.

The committee on constitution having completed its work then made their report, which was followed by the adoption of the following constitution and by-laws. But few changes were made in them as reported by the committee.

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CONSTITUTION AND BY-LAWS OF THE MICHIGAN STATE ASSOCIATION OF FARMERS' CLUBS.

PREMABLE.

We, the delegates from various Farmers' Clubs of Michigan in convention assembled, realizing the importance and efficacy of organization in the promotion of ideas and the advancement of measures of general interest and benefit to the agriculturists of this state; believing that the social, moral, intellectual and financial condition of the farmer is advanced by local organization of farmers' clubs; and that the organization of other local clubs will be promoted by a central or state association of clubs already in existence, and believing that such an organization would be a valuable means for the interchange of ideas and securing of ends which may be deemed of general benefit to the farmers of this state, do hereby adopt the following constitution and by-laws for the government of such an association:

CONSTITUTION.

ARTICLE I—Name—This organization shall be known as the Michigan State Association of Farmers' Clubs.

ARTICLE II.—Objects—The objects of this association shall be as set forth in the preamble.

ARTICLE III.—Officers—The officers of this association shall be a president, vice president, secretary and two directors, whose duties shall be such as usually devolve upon such officers, except that if occasion requires the secretary shall also perform the duties of treasurer.

ARTICLE IV.—The annual meeting of this association shall be held in Lansing on the first Tuesday and Wednesday of February in each year.

ARTICLE V.—The officers of this association shall be elected at the annual meeting by ballot, a majority of all votes cast being necessary for an election. The president, vice president and secretary shall be elected for one year, and one director for one year and one director for two years, but after the first organization, one director shall be elected at each annual meeting and for a term of two years. And no officer shall be eligible for re-election except the secretary, who may be re-elected by a three-fourths vote of all the delegates present.

ARTICLE VI.—Any Farmers' Club in the state of Michigan may become a member of this association by certifying to the secretary of this association its desire to be so enrolled.

BY-LAWS.

1. The officers of this association shall constitute an executive committee, the duty of which shall be to prepare a program for the annual meetings and to perform such other duties as may properly devolve upon an executive committee.
2. Each club shall be entitled to send two delegates to the meetings of the association.
3. The officers of this association shall assume the duties of their respective offices immediately upon their election.
4. The Faculty of the Agricultural College shall be admitted to all the privileges of the floor but shall not be entitled to vote.

Amendments—The constitution or by-laws may be amended at any annual meeting of the association, provided the proposed amendments shall be published in the *Michigan Farmer* and *Grange Visitor* over the signature of the secretary at least four weeks before the annual meeting. Such amendments shall require a two-thirds vote.

Hon. Wm. Ball, of Hamburg, then addressed the convention. We give the larger portion of his address:

It seems to me that one of the duties which this convention should perform is to try and establish some uniform system of work for different clubs, so that by a unity of effort much more good may be accomplished than by each club working alone. The success which crowns the effort in all departments of the business of the world is achieved mainly by organi-

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zation and co-operation. Man, wandering alone with his ideas not in common with his fellow man, has but little chance in the scramble for wealth or mental improvement.

The history of mankind from the beginning all goes to prove that where reorganization was the most perfect, and in accord with the ends sought, there the best results were obtained. Successful military achievements have nearly always been attained in the greatest degree in proportion as the central organization was the most complete, and acting in harmony with those co-operating with it. The more thorough the organization in all departments, the better drilled and equipped the soldiers were in all divisions, corps, regiments and down to the corporal's squads acting as one great whole, the greater and more important have been the results. The central organizations of governments, sustained by State organizations acting in unity make this nation invulnerable against the attacks of any foe. The gigantic business operations of the world are conducted mainly by intelligent organization and active co-operation. The principal of centralized power is acknowledged in a thousand different forms. The great success in the religious world is mainly due to organization and agreement in methods. The success attending the secret and benevolent societies all over the world attest its value. By the use of this principal corporate capital is enabled to declare dividends to stockholders. Organization is the power that controls the business world. It enables these collosal institutions to employ experts in every branch of their business. By a system of yearly comparisons it enables them in advance to forecast the future, and under ordinary circumstances to determine profits or loss, and in what particulars the management needs changes to assure prosperity.

By organization the different systems of railroads competing with each other are enabled to harmonize their differences and fix mutual tariff rates, which you and I, if we be shippers, must pay if obliged to use the roads.

Through organizations the laboring men of the country expect to be better able to meet the encroachments of corporative greed and extortion. Corporative capital in the form of syndicates in a large degree controls the prices of nearly all the products farmers have to sell. While in some instances they are beneficial from the fact that they furnish a steady market for surplus agricultural produce, they are in the main injurious to the farmer's best interests by their greed and rapacity. I think it may be truly said that nearly all the business of the world (including preaching, teaching, etc.) is under the control and direction of organized effort. If co-operation is so essential to success in legislation, in military operations, in benevolence, in social, religious and literary work, in the successful business operations of the world, it is equally necessary in the business and social life of the farmer. This principle has been recognized to a certain extent by farmers' organizations known as the Grange, Patrons of Industry, Farmers' Alliances, Farmers Leagues, etc.; but excepting the Grange their influence has been impaired by their being merged into political associations. The Grange has in the main stood aloof from political pollution, and consequently has been, and is doing, a good work in many parts of the State and nation in its effort to make farming better and more remunerative, and farmers more intelligent. I do not forget the fact that some men have used it as a means by which official honors have been secured, who perhaps could not have succeeded upon their own merits; but in the main the work done by it has been in the interest of the farmers, assisting greatly in reducing the price of many articles of consumption

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and use so that a farmer could afford to buy; in fighting patent right swindlers, in the establishment of a department of agriculture on a plane with other government departments, as well as being in many other directions beneficial to agriculture. More recently many farmers' clubs have been organized in different parts of the State, which are doing a vast amount of good in the localities where they exist. Better farming is the result. More pride in the looks of the farms in such vicinities where meetings of the clubs are held; more care is taken in clearing the fields and streets of noxious weeds; better care is taken of tools, and a greater degree of intelligence on many subjects is the natural sequence of such organizations. Every township in the settled portion of the State should have one or more farmers' clubs at whose meetings should be discussed the more modern and best methods to be pursued in farm management, the needs of the world and where supplies are to come from, how to avoid the bad effects of yearly drouths, the inprovement in stock raising, feeding and breeding, butter making, fruit growing, poultry and bee keeping, improvements in literary pursuits, and how to make the farmers' life more sociable and enjoying. These are all objects worthy of careful thought and attention.

That there may be an impetus given in the direction of increasing the numbers of farmers' clubs in this State, that a more uniform system of work may be arranged for the various clubs in the State, that some plan of action may be devised that will enable the farmer to more successfully meet the encroachments of centralized capital, that as farmers representing all parts of the State some plan may be formulated whereby the needs of the farming community shall receive that respectful hearing by our law makers that is accorded any other industry in this country, are some of the reasons which undoubtedly induced the members of the different clubs to call this convention of delegates at this time.

The good that may result from this meeting will depend largely upon the action which you may take. It would seem necessary that something in the form of a constitution, or formula for future action, should be adopted. The political rock upon which many farmers' organizations have gone to destruction should be given a wide berth. The mistakes of the past should be the beacon light for the future.

Without being able to know the views of the different delegates present as to their plans of action, I have at random touched upon some of the historical results of organization in its various forms, and have ventured to make some suggestions that may be of benefit as a basis of work which we have now to perform. There are many topics of interest, many questions of importance not mentioned, but preferring that you should determine what they shall be, I will leave the subject in your hands to take such action as may be deemed advisable and proper.

Before assembling for the final session on the afternoon of February 2, the delegates very generally expressed approval of the work being done at the college, and particularly in the new dairy school.

The secretary read the following list of clubs represented, and their delegates:

Highland and Hartland, Oakland Co.—A. C. Bird, Highland; H. W. Nichols, Highland.

Ingham, Ingham Co.—L. H. Ives, Mason; A. Templeton, Mason; Col. J. A. Shannon, Mason.

Webster, Washtenaw Co.—E. Nordman, Dexter; Hon. Wm. Ball, Hamburg.

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Stockbridge, Ingham Co.—W. C. Nichols, Stockbridge.
Union, Clinton Co.—Wm. Woodbury, St. Johns.
Spring Arbor, Jackson Co.— F. W. Fowler, Snyder; J. A. French, Spring Arbor; Henry Tefft, Spring Arbor.
Parma, Jackson Co.—B. F. Packham, Albion.
Odessa, Ionia Co.—B. A. Waches, Lake Odessa; Henry Stinchcomb, Lake Odessa.
Burton, Shiawassee Co.—F. M. Shepard, Owosso.
Grass Lake, Jackson Co.—M. L. Raymond, Grass Lake.
Concord, Jackson Co.—F. J. Goodrich, Concord.
Essex, Clinton Co.—J. T. Daniells, Union Home.
Paw Paw and Antwerp, Van Buren Co.—C. W. Young, Paw Paw.
Argonaut, Oakland Co.—A. N. Kimmis, Wixom; Frank Durfee, Northville.
Otter Creek, Jackson Co.—H. D. Griffith, Otter Creek.
Olive Branch, Oakland Co.—R. K. Divine, Holly; D. D. Hadley, Holly.
Liberty, Jackson Co.—H. D. Wetherby, Liberty.
Napoleon, Jackson Co.—C. S. Pentecost, Napoleon.
Maple River, Shiawassee Co.—E. J. Cook, Owosso.
Saline, Washtenaw Co.—H. D. Platt, Ypsilanti.
Grand Blanc, Genesee Co.—C. Clark, Grand Blanc.
Sunfield and Deerfield, Monroe Co.—E. C. Lockwood, Petersburg.

The election of officers for the ensuing year resulted as follows: President, Hon. Wm. Ball, Hamburg; vice president, A. Templeton, Mason; secretary, A. C. Bird, Highland; directors, one year, R. K. Divine, Holly; two years, F. W. Fowler, Snyder.

The following resolutions were unanimously adopted:

Believing that one of the primary reasons that induced the different farmers' clubs in the State to so nobly respond to the call made for this convention was the belief that some uniform system of future work would be devised and adopted that would be an aid to the different clubs in the work which they are endeavoring to perform, in order that this may be accomplished it is

Resolved, That a committee of three be appointed by the chair, to arrange a program with a sufficient number of subjects for the consideration of the various clubs (now formed as well as those likely to be formed) for one year.

Resolved, That it is the sense of this association that all possible encouragement should be given towards the formation of farmers' clubs in localities where none exist, to the end that the acknowledged benefits of said organizations may reach a larger number of farmers.

Resolved, That we earnestly believe the shortest road to the position our numbers as farmers indicate we should occupy in the state and nation lies through the cultivation of that increased intelligence, fraternity and unity, which results from active participation in the work of well organized farmers' clubs.

Resolved, That, while much latitude should be given, in discussing all questions relating to the financial, political, social or intellectual interests of farmers all farmer's clubs should be non-sectarian and non-political, and that in no manner should they be used as an aid in partisan purposes.

The chairman appointed the following committee to prepare the program mentioned in the resolutions:

L. H. Ives, Mason; J. T. Daniells, Union Home; M. L. Raymond, Grass Lake.

It was voted that the proceedings be published in the *Michigan Farmer* and *Grange Visitor*.

After a short address by Gov. Rich the convention adjourned.

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FARMING IN THE UPPER PENINSULA.

It has been, and is now, the impression among residents of the lower peninsula of Michigan, that farming was of little interest in the upper peninsula of the State.

The large wealth of mines and forest has so overshadowed the agriculture, and the high latitude, has given the idea that farming was not worth the attempt in that region. But those conversant with the soil and climate of that section of the State have all along claimed that there were capabilities in that direction unthought of by residents of the older part of the State.

The following from the Norway Current, of June, 1894, will serve as an introduction to a description of what is possible and of what is being done in one county:

We are glad to note that in previous issues of this paper we have voiced so nearly the opinion of business men like Mr. Spalding, in the assertion that this stump land hereabout is good for something, and mighty good, too, if its conversion to the uses of civilization is undertaken in an intelligent manner.

During the years that have passed, this paper has said much regarding the numerous farms on the State road and of the possibilities of the future. Among other things it has been in the habit of calling the Sturgeon farm (better known as the "New York farm") of the M. R. L. Co., "a model farm," and some of our friends, from time to time, who visit us from other sections, say: "Where is this crack farm of yours which you talk so much about, with its hundreds of acres of stumpless land, its score of buildings and its hundreds of cattle, hogs, sheep and horses?" And to show that we sometimes tell the truth, we "hitch up" and drive out to the farm and turn the doubting Thomas over to the tender mercies of Supt. Jouno, who soon convinces him that there is something in Dickinson county other than saw logs or iron ore. We were hardly prepared ourselves, however, for the latest move. Last week, Supt. Jouno invited us to take breakfast with him at the farm, Sunday, as he had something to show us. Overcoming our reluctance to get up so early Sunday morning, we were on hand and found that we were not the only "stranger within the gates," as we met there Mr. Jesse Spalding, of Chicago, president of the company; Mr. M. Corry, of Marinette, treasurer and general manager; Mr. J. F. Hancock, of Marinette; Mr. J. M. Martin, superintendent of the Sawyer-Goodman Co., Marinette, and Mr. J. A. Campbell, of the firm of Martin & Campbell, Marinette. Later the company was increased by the arrival of Capt.

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J. U. Curnow, of East Vulcan, and Mr. Richard Underwood, of the State road (the man who calls himself "only a poor farmer"). We soon found that we had been invited to the birthday celebration and christening of the "New York Farm Creamery" with Hon. Jesse Spalding as sponsor. After breakfast, the whole of the new institution was carefully examined, and the efficiency of the new machinery fully demonstrated. It is of the most modern type from separator to butter worker, and has capacity sufficient to take care of the milk from 150 cows. The services of an expert buttermaker have been secured and henceforth a package labeled, New York Farm, Vulcan, Mich., Pure Creamery Butter, will make a man who is short on shekels, break at least one of the commandments.

"During a conversation with Mr. Spalding he said, in substance, the following: "This is something of an experiment. I have long thought that there will come a day where every acre of arable land in this part of the country will be made to produce something. The sawlogs and other wood products are fast becoming exhausted, and perhaps the output of iron ore will in time be also limited. Then what? Shall we allow the improvements found necessary and profitable during the past, to fall into a state of nature, or shall we demonstrate now that there are other possibilities? I contend that a fat hog, a good veal or a package of good butter is always marketable, and the only question is whether or not they can be produced and sold at a profit. I claim that they can, and as an evidence of the faith that is in me, we have put in this plant. We expect to use the skim milk and buttermilk for our calves and hogs, and we know that our land produces good hay and root crops and fodder corn, and that we have around us the elements of success. There is another thing. There are in this section a large number who have farms not on so large a scale as ours, who do not wish to establish creameries, but who would keep more cows were they assured of a market for their milk. These we shall be prepared to accommodate in such manner as may be mutually agreed upon. Yes, I say again, when this rush for iron ore and sawlogs is over, then the sheep, the cow, the calf, the hog and the butter tub will come to the front and they will come to stay."

After reading the foregoing, the secretary wrote to Hon. Jesse Spalding, president of the Menominee River Lumber Co., who are improving some of their stump lands, to learn the condition of farm improvements and something of the prospects, relating to agriculture of that region.

The following is here published as statements of these conditions in 1894 in Menominee county. There are other counties of the upper peninsula that have equally good soil, and in which lands are being improved, of which we hope to give some account in the next annual report.

MENOMINEE RIVER LUMBER CO., LUMBER MANUFACTURERS, AND GENERAL MERCHANTS, CHICAGO, ILL.

MR. I. H. BUTTERFIELD, *Sec'y State Board of Agriculture, Lansing, Mich.*:

DEAR SIR—In answer to your letter I have the pleasure of submitting the following statement and of enclosing letters from G. H. Haggerson of Spalding township, L. Nadeau of Nadeau township, and W. J. O'Berdorpper of Stephenson township, all in in the upper peninsula of Michigan. These men are the supervisors of the townships named and give the real situation as to farming and dairy interests in their respective townships. In regard to the New York Farm and Creamery near Vulcan, Mich., would say: This farm is located on the Menominee river, at its junction with the Sturgeon river and its area at present is 700 acres, 500 acres of which are stumped and under cultivation. This cultivated area is increased each year by from 40 to 80 acres. On

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the farm are the following buildings. One farm house, woodshed, and water tank. A two-story root house, a two-story tool house, a frame stock barn, with stable attachment, a cow barn with 58 patent stalls, a warehouse, a horse barn, a sleigh barn, a blacksmith shop, a dwelling house, a pump house, ice house, and water tank.

There is a 6-inch horizontal Worthington pump with upright boiler capable of throwing a 3 inch stream of water 400 feet. There are 800 feet of 6 inch main water pipe with 10 hydrants to which can be attached 3 inch hose and 500 feet of 3 inch hose.

The farm house is a two story and basement modern frame house finished in 1890 at a cost of $5,000; it is furnished with hot and cold water. The creamery is located in the basement of the farm house and is furnished with all the modern improvements. It is what is called a 60 cow creamery, that is, it can take care of the milk from 60 cows. The creamery was started May 25, 1894, with 25 cows. Three of the cows were old however and six of them two year old heifers, so that really there were but 16 good cows available for the season. But with these disadvantages the creamery showed a credit of over $500 at the close of the season October 15, 1894. The summer was unfavorable as no rain fell from the 15th of June till the end of September, and pasture was very poor. Next season the creamery will probably do better as there will be 40 cows to milk. The stock is chiefly Jerseys and Guernseys and the butter produced sold at Vulcan for 20 and 25 cents per pound.

The following is a statement of the crops raised on the Sturgeon or (New York) farm for five years past.

Hay tons	850	Peas bushels	309
Oats, bushels	24,611	Wheat "	113
Barley "	855	Buckwheat "	191
Potatoes "	15,346	Cabbage, heads	5,300
Carrots "	1,052	Pickles, barrels	25
Ruta bagas bushels	2,555	Turnips, bushels	2,250
Beets bushels	1,169	Peas and oats, bushels	130
Onions "	2,015	Straw, tons	50

All garden vegetables are grown successfully, and last spring an orchard consisting of 300 apple, plum, and cherry trees was planted. The trees are doing well. Other farmers near by have been very successful in raising apples, plums, cherries, and small fruits, raspberries, strawberries, and currants. There is a flock of about 130 Cotswold sheep on the farm. They are very hardy sheep. The pigs raised are mixed Poland China and Berkshire.

Twenty-five new settlers have located farms near this point within the last year. There is any quantity of good farming land for sale in this vicinity at a low price and on easy payments.

Yours truly,

JESSE SPALDING.

Spalding, Mich., December 8, 1894.

MR. I. H. BUTTERFIELD, *Sec'y State Board of Agriculture, Lansing, Mich.:*

DEAR SIR—Replying to yours of November 13, to Mr. Jesse Spalding of Chicago, asking for information in reference to the farming and dairy interests in this part of the state: We have in the township of Spalding about 225 farmers, the number of which is increasing every year. The amount of cleared land in the farms range from 15 to 160 acres each. Most of them ranging from 25 to 40 acres each.

Wheat, oats, and rye are the principal grains raised. During the past two years wheat has averaged about 20 bushels to the acre and oats over 30 bushels to the acre. Potatoes are extensively raised and are always a good crop. Timothy and clover average about 1½ tons to the acre and are very rich in butter producing qualities on account of the limestone formation in the soil.

Two years ago a creamery was established in the village of Spalding. During the year 1893 the supply of milk brought to the creamery by the farmers averaged 1,500 pounds daily. During the year 1894 the supply had increased to 2,500 pounds daily, and for the year 1895 it is expected that the supply will increase 50 per cent over that of 1894, as farmers are all increasing their stock of milch cows. The yield of butter averaged 4½ pounds to 100 pounds of milk during the past season. Other creameries are also being established in this vicinity.

Menominee county is being well opened up with good roads. One year ago the county road system was adopted in Menominee county, during the year of 1894 twenty-five thousand dollars was expended on county roads in this county and during the year

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1895 thirty-five thousand dollars will be expended on them besides the moneys expended by the townships on townships roads.

Good farming lands, well timbered, can be bought by bona fide settlers in this vicinity, at reasonable prices and on easy terms. There is always a good market for the timber products and a good home market at the lumbering and mining towns in this vicinity for all farm products.

I have asked Mr. W. J. O'Berdorpper and Mr. Louis Nadeau, who have been supervisors of the adjoining towns of Stephenson and Nadeau respectively, for several years past, for their views and herewith enclose you reports received from them.

Will you kindly furnish me with a few copies of the report the State Board of Agriculture may make on the information herewith given and oblige,

Yours truly,

T. H. HAGGERSON.

Nadeau, Menominee Co., Mich., Nov. 16, 1894.

DEAR SIR—Replying to your favor of this date, I will cheerfully give what information I can, but as there is so little system to the farming done in this vicinity it is impossible to give anything like definite figures as to results obtained. I can, therefore, only speak of the matter generally, and somewhat from experience.

The farming here has been very much neglected, as the main dependence has been the woods and the usual course for settlers is to hurry in a small crop in a few days in the spring then go to work in the woods, the result has been very little improvement in the farms. We notice, however, a very marked change in this recently, and this fall on most all farms in this vicinity large fields have been cleared of stones and stumps and plowed ready for spring seeding. Also considerable has been seeded to fall grain wheat and rye. Practically nothing has been done here in the way of dairy farming. This having been confined to a few cows kept by each farmer. While this does not appear to amount to much, is still considerable in the agggreate, and this fall is quite noticeable in the amount of stock being offered for beef. The demand here has been largely supplied with home products in beef and pork since the cool weather sets in, which is something new for this place and indicates probable large increase in our live stock business in the near future. I think from my observation and some experience in that line, that our lands are particularly well suited for this line of farming, while the seasons are short I think our pastures will average more days of good grazing than in many localities further south. We turned out our cattle the first week in April last and gave them no feed till the recent cold set in about the first of this month, and they are in fine condition notwithstanding our extremely dry season. Considering also that our lands produce the best of hay, clover, and corn for fodder, and potatoes and all kinds of roots, leads me to think that our farmers will realize the advantages of this locality for dairying and stock raising.

As to grain we raise very good wheat, rye, oats, and barley. We sowed last fall seven bushels of rye and thrashed out 215 bushels, and it was damaged some by being overripe when cut and shelled out badly. Oats were a very good crop but injured considerably in some fields by the "Army worm." I would be pleased to give you something more definite regarding yield per acre of different crops, but am unable to do so, as I do not know of an instance where a farmer can say how many acres he has to any particular crop. If this is very important I will make inquiries and see what further information I can obtain for you.

Yours truly,

L. NADEAU.

Stephenson, December 3, 1894.

GEORGE H. HAGGERSON, *Spalding, Mich.:*

DEAR SIR—Your letter asking for my views on the condition and advancement of the farming interest in this portion of the state was received some time ago. With a feeling that I shall not be able to do this matter justice will now try and give a few outlines regarding the present condition and what I consider the future possibilities of the farming interest in this part of our great state of Michigan.

It was in 1875 when some few of our hardy woodsmen became converted to the idea that potatoes might be raised at a profit on the hard wood lands in Menominee county. To test the matter they took up a homestead. One year's trial convinced them that they were right. Oats were tried next with results beyond expectation. The third year one of the settlers imported one peck of wheat for seed, it was sowed and harvested, and after two days of threshing with a flail he finally cleaned up eight bushels

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of wheat. This proved an eye opener for the future. In the meantime other settlers began to come in, the woods became dotted with little openings and log cabins. The majority of them were Scandinavians, and although working under great disadvantages, and undergoing privations such as pioneers only know of, they went at it with a will, and the little clearings soon began to assume proportions. Hay, rutabagas, and all sorts of garden vegetables were soon added to the list of growing crops with enormous yields.

Roads were being built, and school districts were organized, and people came thick and faster, looking for an independent home in the woods. Every year added from two to ten acres to each man's farm, till today we find from 20 to 80 acres of cleared land in each farm. The number of farms in this (Stephenson) township is over 300 now. We have nine townships in Menominee county, and the majority of them have experienced the same rapid advancement of the farming interest. This past year wheat has yielded an average of about 18 bushels per acre. Oats about 30 bushels per acre. Rye and winter wheat yield well and will be extensively raised in the near future. Flint varieties of corn are grown to a considerable extent with success. Hay will yield an average of about 1½ tons to the acre. Such yields as 30 bushels per acre of wheat and 50 bushels per acre of oats are frequently found under favorable conditions and thorough cultivation. The only flouring mill in the upper peninsula is located in Menominee county, it was built in 1891 and has a capacity of 120 barrels per day. Its custom work the first year amounted to 3,000 bushels. This year the custom work will exceed 10,000 bushels of wheat.

Stock raising is beginning to receive some attention, from four to twenty head of stock may be found on every farm.

Two creameries with the latest improved machinery, have been successfully operated during the past two years. One located at Spalding, another at Stephenson (this county). This branch of the business will prove one of the greatest resources to our farmers in the very near future. It is true that we have some disadvantages to contend with caused by our geographical location, our winters being a little longer than in some of our more southern neighboring states, yet the difference is but very slight as compared with Wisconsin and northern Illinois. The beneficial influences cast over the southern portion of this state by the great lakes in no small degree extend over this northern part which borders on these immense bodies of water. The moderating waves may be traced for many miles inland, when we hear, as we frequently do, of frost nipping the corn in Minnesota, Wisconsin, and northern Illinois in the early fall. To offset anything of this kind we can mention many advantages not enjoyed by farmers in many other states, one of which is a home market in the mining and lumbering districts of the upper peninsula. Train loads of farm produce are being shipped up here every day from other states which might be produced right here at home.

Our farmers here can load up their surplus farm produce and deliver it to the consumer in one day's journey, saving the enormous freight charges paid by farmers of other states. There is one more point I wish to score in favor of the farming interest here, although some of our farmers do not yet seem to be aware of the benefits that are in store for them from this source upon which the amount of their future bank account will mainly depend. I am pleased to note that some at least are giving this matter the attention it deserves. This secret can be explained in the one word clover. It is the backbone of all modern and scientific farming, and I will venture the assertion without fear of successful contradiction that there is not another spot on all of God's green earth where clover flourishes better than it does in this portion of Michigan. Its main value lies in its fertilizing qualities and in its relation to the dairying interest. The finest of clover fields may be seen here all through the summer, in fact until snow hides them from view in winter. While the farmers of southern Wisconsin and Illinois are devoting the greater portion of their lands which are worth from $50 to $100 per acre to the dairying interest why should it not prove profitable here where the best of pasture lands can be purchased for from three to eight dollars per acre, with better prices and a home market for all the butter that can be produced? Another source of income may be made available in the item of clover seed. At the present time there are many hundreds of dollars paid out by our farmers every year for clover seed, and there are thousands of bushels of clover seed going to waste in this county every fall seemingly unnoticed, simply for the want of being harvested. This upper peninsula is capable of supplying the whole United States with clover seed, and the day is not far off when this fact will be recognized and prove an important item.

There is much more which remains to be said and yet I think I have written enough to show that the future of the farming interest here is much brighter than a great many of us are aware of. Our county authorities are doing all in their power to foster the interest. Twenty-five thousand dollars were expended in the improvement of roads

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this past summer and the results have been so gratifying that another amount of $35,000 will be expended next season for the same purpose. In addition to this each township in the county is expending from $2,000 to $5,000 annually in the building of new roads, and by the close of another season the roads of this county will be second to none in the northwest.

We have a good and efficient system of public schools. Six new school houses have been built in this (Stephenson) township during the past two years at a cost of about $800 each; in all we have eleven schools and employ fourteen teachers. Other townships are making advancement in this line in the same proportion.

In conclusion I think it is safe to say that when the history of the state of Michigan is revised the upper peninsula will not again be placed on record as a barren waste.

Yours truly,

WM. J. O'BERDORPPER.

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INSTITUTES.

Farmers' institutes were held during the year under direction of the board, Hon. A. C. Glidden in charge, as follows: Four long institutes of ten sessions each, at Greenville, January 9-12, attended from the college by Pres. Gorton, Prof. Hedrick, Prof. Smith, Mr. Coryell, and Dr. Manly Miles, employed by the board;

At Grand Ledge January 16-19, attended by Pres. Gorton, Profs. Smith, F. S. Kedzie, Dr. Miles, Mr. Coryell;

At Battle Creek January 23-26, attended by Mr. Glidden, Pres. Gorton, Profs. F. S. Kedzie, Smith, Vedder, and Miss M. M. Sill, employed by the board;

At Coldwater January 30 and February 2, attended by Pres. Gorton, Prof. Smith.

Short or five session institutes were held at Allegan, Allegan county; Alto, Kent county; Shelby, Oceana county; Hersey, Osceola county; Alma, Gratiot county; Standish, Arenac county; Yale, St. Clair county; Highland, Oakland county; Stockbridge, Ingham county; South Butler, Hillsdale county; Cassopolis, Cass county; Niles, Berrien county; attended from the college by Dr. Beal, Profs. Smith, Taft, F. S. Kedzie, Dr. R. C. Kedzie, Dr. Grange, Prof. Mumford, Mr. Gladden, Mr. Coryell, Pres. Gorton, Mr. Wheeler, Mr. Davis, and Hon. William Ball, employed by the board.

The institutes were generally well attended and a marked interest was exhibited. It is believed by those who conduct these meetings that a more extended system covering at least one institute in each county in the State where agriculture predominates would be of great advantage.

Beside these regular institutes the college was represented at the State Dairymen's association meeting at Saginaw, at the Live Stock associations at Lansing the State Horticultural society meetings at Lawton and Charlotte, and at a number of local institutes and farmers' club meetings. June 16 the Ingham county farmers' club met at the college with a large attendance.

The interest in institutes and other meetings of farmers and country people betokens much advance in intelligent farming. It is hoped that the Legislature will materially increase the appropriation so that institutes can be held in each county annually.

LIVE STOCK BREEDERS.

The Association of Breeders of Improved Live Stock met at Lansing December 19, 1893.

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This association which comprises breeders of all the improved breeds was organized in 1890. Its first officers were Pres. Wm. Ball; secretary I. H. Butterfield; treasurer H. R. Kingman; directors Samuel Johnson, John T. Rich, Geo. E. Breck, L. W. Barnes, Jas. M. Turner.

The officers for 1893-4 are president, Geo. E. Breck; vice president, W. Boyden; secretary, I. H. Butterfield; treasurer, H. A. Flint. At the meeting of 1893 the following are among the addresses delivered:

PRESIDENT'S ADDRESS.

GEO. E. BRECK OF PAW PAW.

Gentlemen of the Improved Live Stock Breeders' Association and Friends—I bid you a hearty welcome to this, our fourth annual meeting, and hope that you may find your time profitably spent here. I would that all breeders in Michigan might participate in the meetings of this association that we might have the benefit of their practical ideas, and that they might receive inspiration from meeting their fellow breeders and hearing our papers and discussions.

One year ago we looked forward to the World's Fair as an important event to stock breeders, and in this we have not been disappointed. The Columbian exposition has set the pace and fixed the standard for all future live stock exhibits. We have learned that the breeders who are able to compete in the exhibit of horses, cattle, sheep, or swine at our best shows are comparatively few, and that what a few years ago was a winner is now found at the foot of the class. In no department of agriculture has the improvement been more rapid and marked than in the breeding of domesto animals.

As a result of the action of our association one year ago, our State has made a creditable exhibit at the World's Fair, but this exhibit was not as good as might have been made had our commission given us the encouragement which it should at an earlier date. To the credit of this association be it said that had it not been for our action last winter we would not have received such assistance as to encourage a proper exhibit. Resulting from that action the State commissioner has paid our freight and forage bills cheerfully and generously, and made the exhibit a profitable one for the breeders and a creditable one for the State. It well illustrates what may be done by associated action and the bringing to bear of the influence that our members have in State affairs when once they set about it.

The general farming situation is not satisfactory and is not promising, and a feeling of gloom is prevalent even among farmers who are free from debt, and are frugal, industrious and skillful. Grain raising on lands worth from $40 to $100 per acre must be abandoned under present prices unless it can be profitably converted in to animal food. It seems to be a question of whether strong, intelligent, able men shall abandon the vocation in which their forefathers prospered, and to which they are strongly attached and in which they have been trained from youth, or, to save themselves from irretrievable loss through competition with the cheapest possible production of grain, try new methods of farming that to them are experimental, but with the hope that they may produce more dollars worth per acre, produce cheaper or find less competition.

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Well may farmers be thankful, however, that in 1893 they did not belong to the manufacturing, banking, or mercantile portion of our people, lest like them they should now be brought to face bankruptcy or starvation. While a large percentage of well equipped, well managed business enterprises have been ruined, the farmer has been able to sell for cash and pay his debts when others could not. Farm products have turned the current of gold toward our shores and saved our country's credit, and the farmer has his farm, tools and stock ready with which he can at least maintain a comfortable home. I doubt if there is another industry that can show a better financial condition, and surely there are none that are freer from the disasters attending strikes, failures and panics. The poverty of the cities and the farmers in foreign lands is unknown to the farmer of America, and is there another vocation that can give greater assurance of happiness and competency in return for industry and intelligence? This prospect should draw to the ranks of the farmer from the cities a few thrifty people with small means, who will seek a small farm where they may feel secure from the loss of all they have and be sure of at least a living, thus making sales for farm lands and giving a better tone to agriculture.

But we are not only farmers, but breeders of improved live stock as well, and while the year so auspiciously begun has not proven as prosperous as we had reason to expect, we shall not retire.

Horses have been so low that there is little demand for them for breeding purposes, but this condition cannot last always. Few horses are being bred at present, importation has almost entirely ceased, and horse ranches and large breeding establishments are now few. Mankind is attached to a fine horse and there is no machine that will ever permanently take its place in man's pleasure or business. Who does not believe that the horses that have been replaced by electricity will find another sphere of usefulness or who believes that man will always be satisfied with a bicycle for a pleasure ride? As he sees himself gradually losing lung power and doubling up like a hoop snake, he will become disgusted with it and return to the pleasure of the horse and carriage. There will always be a good demand for good horses for the truck, coach and turf.

Good cattle have met profitable sales and unless our judgment is sadly at fault there is not an over supply of choice beef, while there is a demand both in America and Europe for such beeves as our best breeders are now offering, and the demand is improving and will soon outrun the supply, when profitable prices will be offered and the best breeding animals will find ready sales and good profits.

Eighteen hundred and ninety-three has seen swine breeders at the bat. Every one at the World's Fair was enquiring for that "big hog." Breeders have had unprecendented sales, both as to numbers and prices, and none of us will envy them their success. The swine breeders have done their full share to establish the reputation of the American farmer as a breeder of improved live stock. They have given us at least one breed of animals that is not surpassed in either perfection of type or individual by an alien breed. We congratulate our friends, the swine breeders, on the success of the year, and will not refuse an invitation to dine at their expense and be hilarious with them.

At our last meeting sheep breeders were at the helm, with stud flocks small and commanding good prices. Sheep feeding was profitable with good sheep and grain twenty per cent higher than at present. Since June

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last we have seen wool bringing the lowest price that it has brought for thirty-five years, and some classes of wool have been entirely unsalable. Mutton prices have rapidly declined and been attended by such a rush of inferior sheep to the stock yards that sales at any price were next to impossible, and choice mutton sheep have not escaped the decline. Men will stand a decline of two cents per pound in cattle or hogs without loss of confidence, while a loss of the same amount on sheep will cause a panic among them. This we have lately seen when our sheep were improving in quality more rapidly, under favorable influences, than any of our other live stock. Free wool and tariff prospects, at a time when our people are producing wool far short of the quantity needed to clothe them, have alarmed us and are chargeable with the blame. But the sheep industry has a permanent place in our husbandry and no change of parties, or legislation, or tastes, or systems is going to replace it. The great ranches of the world, and the average farmer will always look to the skillful breeder for stock rams and foundation flocks of the best sheep, and he who can supply this class of stock and will use honest business methods is in no danger of a losing investment.

But sheep breeders are not alone in deploring the changes wrought by the last national election. From Hon. Jeremiah Rusk, the climax of whose reputation was capped by his able services as Secretary of Agriculture, and whose heart ever throbbed with an honest purpose to serve our interests, to Hon. J. Sterling Morton, who has not creditably filled a position created to serve the agricultural interests. What a change! ! It well illustrates the disposition of a people for a change for the sake of a change. In grasping for more we often lose that which we have. Our people will do well to follow the lead of the best agricultural papers in demanding that the position of Secretary of Agriculture be made one for the attainment of practical results in maintaining and extending the sale of our products in foreign lands, and not a mere sinecure nor political reward. But political parties must establish in themselves the confidence of the business interests of the country, or be replaced by one that will, and panics are of short duration.

The breeding of improved live stock has a permanent place in the agriculture of the future. Under changed conditions it will be given greater prominence than heretofore, and while breeds and breeders may have their ups and downs, the business of the intelligent stock breeder, who commands so much of practical value in the reproduction of the desirable qualities and perfection of form in our domestic animals, is indispensable to modern agriculture. As breeders we have in hand the sure foundation of future profitable farming which will not tolerate a scrub that is not susceptible of proper assimilation of high priced food and that will not respond to extra care, nor the full blood animal that is commendable only because of a good pedigree. It will demand those desirable qualities so "bred in the bone" as to warrant their uniform transmission and the elimination of disease and defects. The fundamental principles of heredity alone insure uniformity, and the successful breeder will both study and observe them. Blood tainted with disease, frequent changes of type, radical crosses and experiments must be avoided. We should require that a breeding animal be properly descended for several generations without taint, through ancestors of the proper type, and without divergence or reversion as one of the prerequisites to successful breeding. But with a good pedigree must be an individual true to the type of the best of the

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breed and the strongest possible in the most desirable qualities. Pedigree will not alone warrant the use of an inferior breeding animal.

But a good individual properly bred will lose its value under improper subsistence and care, and hence the quantity and quality of nutrition becomes of prime importance to the breeder who would perpetuate and improve upon the stock in hand. A study of the effects of different kinds of food adapted to the chosen breed is necessary and he who is not willing to go to the trouble, expense and labor required to provide breeding animals with the proper quantity and quality of food upon which they have been brought to a high standard had better not invest. Money alone invested in pure bred stock will not run a successful breeding business. Feed and care must attend careful selections and breeding. Feed that simply maintains life without that growth required to develop the best characteristics of the animal results in loss of profit. Every improved breed represented here has its adaptation to some special purpose, and will give good returns for proper food and care, but the breeder must study these carefully or see his high priced animals degenerate to the scrub. In no vocation are intelligence, system, business habits and courtesy more essential than in improved live stock breeding. The demand today for young men capable of managing a good farm or breeding establishment exceeds the supply, while the remuneration offered should induce more to enter this field. Our agricultural college should fit young men for intelligent live stock breeders and point out to them this path of pleasure and profit. They may thus turn to practical use a college course well calculated to fit them for it. Young men do not fear that the intelligent breeding of pedigree stock will become a thing of the past. In no department of agriculture are rewards for success more certain. This business is indispensable to the agriculture of the future even more than it has been to the past, and rewards will correspond with this importance. The breeder's calling is a permanent one and cannot be dispensed with while agriculture remains of prime importance to mankind.

While in England improved live stock breeding has been successful for a century, and is a necessity upon every farm where stock is kept and rent must be paid, the breeder who is willing to invest the large sums requiring to procure high class sires, and who is intelligent, persistent and skillful, is today more indispensable than ever. While an ordinary breeder may furnish an animal with which to grade up, it requires a better breeder to furnish one to improve the grade, and when the grade is perfected and the thoroughbred reached a better breeder must furnish the animal that will still improve the quality. Better and still better must be the motto of the breeder, and he who can breed an animal closest to the ideal has fame and fortune awaiting him. But he requires methods of thought and experience that money will not buy. Stock breeding has proven a pitfall to many men with money and without knowledge of the business. Here money alone will not insure success unless it be found in the pleasure of owning a good animal for the brief period required to lose its sale or show yard form from want of proper food and care. Scarcely one man in ten who is able to buy good animals of any breed will become pre-eminent as a breeder, but this only leaves the field the wider for those possessed of qualities that lead to success. To him the present is an auspicious time to found a stud, herd or flock. High class breeding animals of all kinds can be bought at moderate prices, only a few are required for a foundation, and they will rapidly increase with the experience of the breeder until the

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time comes, as come it surely will, with a returning tide of general prosperity, when everybody will want to go into the business, when his supply will be ample, his reputation made and his sales will be numerous and profitable. Who believes that the price of horses will long remain less per pound than beef or be entirely unsalable? Or who believes that there will not always be a place for the best dairy and beef cattle that will place them above butchers' prices and bring profit to eminent breeders? Or who believes that the men who collectively and traditionally hate the inoffensive sheep, that, when fairly treated, gives its owner a quarterly dividend, will always be left in high places to menace the ancient and honorable shepherd's calling? Witness what intelligent, busines-like direction of the department of argiculture has done for our swine breeders in removing what once seemed impassable barriers, and placing their products upon the markets of every country in the world and placing them in the highway of profit and popularity, and then say to us that stock breeding offers no inducements worthy of our individual ambition or the fostering care of a great nation.

To the members of this association and in their behalf let me say that we have learned that to be successful we must embrace every opportunity for interchange of thought and experience. While elementary principles of breeding are few and generally well understood, the details of breeding, feeding and caring for stock are endless, and with all our experience mutually interchanged as opportunity presents, our failures will still be numerous enough. We recognize the practical utility and desirable social opportunites of a large number of farmers' organizations, and believe they have brought us profit and pleasure, and we deplore any unreasonable attack upon them from any source. As breeders we recognize the indispensable agricultural press that has ever been a trusted leader in the advancement of the interest of the breeder and the general farmer. It is more useful to us than the daily from the great city. We believe in the practical utility of our agricultural colleges and experiment stations, and appreciate the services of eminent men in those institutions, to whom other vocations offer greater reward. And to those breeders who think they cannot afford the time and money to attend this and other organizations, fairs and stock exhibits, and who cannot take the time to read papers especially devoted to their own interests, nor to send their children to college, we must say you are not within the highway to success. As well might you refuse to show your best animals to a neighbor, or refuse to advertise what you have that others want. Either course will lead to certain failure. He who invests ever so wisely in good breeding stock and expects to live within himself will not keep up with improvements.

It would seem as if the present were a time when men can well afford to change from poor to good breeding animals and this applies to both grades and full bloods. At the same time a registered animal that is an unworthy representative of the breed should not be retained, but should be relegated to the place of the scrub. Close selection more than ever before should be the rule now. It never pays the beeder. or the man who cares for his reputation, to sell an inferior breeding animal, although he may find a poor judge that is willing to pay a long price for it. It hurts both the breed and breeder and damages and discourages the buyer. Nor should we fall into a false economy of refusing to have animals that are intended for future breeding purposes recorded in their respective registry associations,

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and a careful individual record of every such animal should be kept, regardless of present prices. Great as may be the temptation under the present depression, it would be a greater mistake to try to save a small registry fee as a matter of economy, for this record is one of the elements of the future value of the animal.

In conclusion let me say that these times cannot last always, and I believe that in no other industry is there a better promise of sure reward than in agriculture, and in no department of agriculture is success more certain or greater pleasure and profit to be found than in breeding improved live stock.

IMPROVEMENT IN TYPE OF BEEF BREEDS OF CATTLE.

BY PROF. EUGENE DAVENPORT OF WOODLAND.

[Read at meeting of Improved Live Stock Breeders' Association, Lansing, Mich., Dec. 20, 1893.]

Any discussion of this topic immediately institutes a comparison of breed types. Moreover, it becomes a critical commentary upon the methods and results of what has been considered and is the best breeding of the world.

For an hundred years and more able and successful men have been giving their fortunes and their lives to the problem of producing better and cheaper meats, and the ideals of these many men find expression in certain specialized forms or types, some half dozen or more of which remain with us today.

As certain families of great men have faded and become extinct before our time, so many excellent strains of cattle—incipient breeds—with valuable characteristics have altogether likely been lost to the world long ago. It becomes important now to enquire into the comparative excellence of the few types preserved, and to ascertain if likely any more valuable than these have been lost.

It is a significant fact that in the "battle of the breeds," though each has a type so distinct that the breed can be recognized instantly by the cultures of the type alone, there is as yet little or no evidence to show that anyone can upon the whole lay successful claim to super excellence above any others that are specialized in the same direction.

That these wide differences in type exist without corresponding differences in ability to produce beef does not in any sense prove the form of the animal to be an unimportant matter. On the contrary it is of great importance, because wherever the form has been left to take care of itself, or in any sense been of secondary consideration, as in the milk breeds, it is accompained by a marked inferiority in ability to produce beef.

We are then to look upon the various forms of our beef breeds as truly and about equally successful beef types. But why and how did such marvelous differences arise? What do they mean? and are they necessary? shall they be preserved? or shall they be merged into some common type for all? This now is an interesting query: Would it have been as easy in the early days to breed the short-horns to the Aberdeen type, and vice versa? and would they have been as excellent breeds today? The real question is, are our breed types as they exist today wholly or even partially accidental? and can they be safely altered or departed from?

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We know that in the early and plastic days of a breed during its formative period it is quick to respond to every caprice of the breeder. But as it is a trick of history to preserve only the victories of our friends and the disasters of our enemies, so it has been with the history of our breeds and their breeding. Who knows how many men in the days that are gone have bred these breeds heroically to different types and found that for some unknown reason they would not stand?

Be this as it may the few forms that have descended to us are the ones that have survived the shocks, abuses and the disasters that the several breeds have experienced. Through long association and severe conditions their characters have become fixed and harmonized, and at this late date it is unsafe to break them up. Those forms are largely the product of natural causes, certainly of natural methods as modified by and adapted to surrounding conditions, and may safely be accepted as the best all things considered that man has been able to produce. If any man thinks differently he will succeed better with new material than with old.

I speak thus at length upon this point because so many inexperienced breeders attempt radical improvements in their chosen breed. This is wrong in theory and disastrous in practice. If any of these types were radically wrong they would not have succeeded so well nor endured so long. It is not too much to say that any substantial *improvement of any breed* is a difficult and somewhat hazardous undertaking in which as in the past but few will succeed and they will be endowed with natural talent, long experience, abundant resources and favorable conditions generally. The average breeder will do well if he preserve the true type of his chosen breed impressed upon his herd.

To succeed in this is no mere child's play. Breeding is a complex not a simple art. There must be no vacillating, no changing of ideals. In other words, let the prospective breeder of short-horns cast about among the several types in this extensive breed, choose one that includes the best short-horns, then breed it and stick to it. Let also the breeder of Aberdeens breed to an established Aberdeen type and forget or ignore the shape of his neighbor's short-horns. If he cannot do this then he should breed short-horns and not doddies.

This typical or perfect animal of whatever breed exists only as a mental conception, an ideal in the mind of the breeder. It will never find embodiment in any single animal. It is built out of perfect characteristics drawn from many animals. That animal is best of his breed that carries the greatest number of typical characters. That herd is best that is most uniform in its characters, providing always they are typical, and that breeder is best who secures by judicious selection and mating a constantly increasing number of typical characters.

Breeders of meat producing animals generally are at a disadvantage as compared with other breeders in having at hand no infallible test of their theories and their breeding. They work largely in the dark. A milking, or a speed or a draft animal may at any time be put to the test in the work for which it was bred, the soundness of its breeding demonstrated and its practical fitness as a breeder established. But the meat producing animal cannot do this thing and live.

But such a test must be made even if it destroy some of our best animals and breeders must cudgel their brains for methods of bringing it about. The excuse has all along been made that a good animal of approved breed-

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ing is too valuable for slaughter, particularly as the information secured could have no possible value after the death of the animal.

But given two or more good animals of the same type and breeding such as the best herds can supply, sacrifice one or more to demonstrate the excellence of the others and the value of those slaughtered is more than added to those that are left. This was the practice of many of the founders of the breeds, and I know breeders today who feed and slaughtered some of their best that their judgment be not led astray and their theories of selection and mating be put to constant test.

The necessity of breeding in large numbers is evident when anything like an advance in breed excellence is sought after. However excellent and well bred the individuals, the very height of development they have attained and the conditions that have brought them, these all stimulate the natural tendency to vary. The progeny of the best of them will wander from the type. Only now and then one will attain to the excellence of the parent, and only occasionally one will exceed it. Of this number but few will impart their characteristics with any reasonable degree of certainty to the next generation, and of these must constant tests be made, all entailing numerical loss. When such an one is found and tested he is indeed a bonanza, and a few in a lifetime will bring fame and fortune to the producer. Few, indeed, have the patience, the skill, the numbers and the capital to do this sort of breeding.

This is a different sort of breeding than the founding of new families or strains for sport, but is the breeding by which final excellence is established and made general within a breed. To this end numbers are essential that the breeder be not hampered in his choice of new generations of breeding stock.

MERINO SHEEP HUSBANDRY.

HON. WILLIAM BALL OF HAMBURG.

In times like the present, when wool is very low in price, and fine wool sheep are like stale goods; when every move made by the powers that now control the financial policy of this country, seem to further depress values and disturb confidence in the future outlook for sheep and wool, it requires considerable determination and energy for one to attempt to interest an association of breeders of the different breeds of stock in the discussion of Merino Sheep Husbandry. Not for the last thirty years has there been any such distrust and lack of faith in the future of the business as now. It is not the province of this paper to discuss the various reasons which exist for this state of affairs, but to try and discover something that may encourage those who have put their money and time into the business of breeding and improving *this*, the most valuable breed of sheep known to the human family, to preserve and not to sacrifice their business and destroy what has taken nearly one hundred years to build up. This association of breeders are *farmers* most of whom (at least) have to make a living out of their farming operations, combining grain growing, stock breeding, fruit culture, or whatever may be best adapted to their farms, markets and inclinations. In looking over the varied departments of agricultural operations, we find the same general stagnation and distrust as in the sheep breeding and wool growing. The price of wheat is below the

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cost of production. Horse breeding is overdone. Electricity is greatly curtailing the demand for horses and there is no bright outlook in that direction. Cattle breeding, especially thoroughbred, are below the cost of raising, and so on through the list of farm operations and stock breeding, unless, perhaps, it be swine and poultry. Hogs at present are bringing a fair price, but it is by the pound rather than an encouragement to the careful breeder who has done so much to improve this very important animal in farm economy. At present no branch of farming or stock growing seems to offer any special advantages over any other branch, but the whole business seems to be under the ban of depression, and as "misery likes company" no one who depends upon the proceeds of his farm for a living, need be lonesome for want of interested sympathizers. With the above described facts existing, and as our farms must provide for our necessities, it seems to me that Merino Sheep breeding (breeding for improvement in quality and quantity of fleece, purity of blood with a gradual tendency to mutton characteristics if without loss to the essential qualities which have made the Merino the superior of all sheep) can still be made profitable and pleasant and further improvement be made in this noble family of sheep. It has been wisely said that history repeats itself. If that be true, then there is in store in the near future, hope and profit for the Merino breeder who sticks to his flock in times of depression as well as in times of prosperity. Men, women and children will have to be clothed in the future as well as in the past. Merino wool is an indispensable factor in the manufacture of the fabrics to be worn. New demands will be made for qualities which can only be found in the Merino fleece, and with improvements to be made, such demands will not be in vain. At the prices paid for wool, low as it is, the demand for Merino exceeds the demand for all other sorts. Thus it has always been and will continue to be. The Merino sheep is the only breed imported which have been improved since the importations proving that it is adapted to the climate and soil throughout the whole length and breadth of this land.

This statement cannot from experience be truthfully made concerning any other breed of sheep. For nearly one hundred years no sheep of the American or Spanish Merino family have been imported into this country. The Merino Registers Associations do not admit to register the product of any sheep imported after 1812. Since that time, wonderful improvements have been made by American breeders. The flocks of imported sheep sheared an average of about five pounds of wool per head in an unwashed state. The flocks of today that have been carefully bred and generously fed, shear from twelve to fourteen pounds per head of a greatly improved quality. The weight of the carcass has been greatly increased, the form and characteristics of the body have undergone a distinct transformation and a type established that is recognized the world over. This improvement has been made by men in this country, who have given the best part of their lives and their best energy and thought to such improvement. The question arises, is it good policy on the part of Merino breeders to sacrifice their flocks and lose the improvements which have cost so much to obtain, on account of present low prices and lack of interest in the business?

The breeder who keeps his best sheep and carefully breeds them, will in a short time be satisfied that he has made no mistake. While history chronicles the names of scores of breeders in this country who have helped to make this breed of sheep high in quality and their breeding

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remunerative, I have not found who has made any marked improvement on the sheep of any other breed imported. The rage seems to be for importations. They sell for far more money, are in a greater demand, proving that those who buy them are buying them on account of the fact that the foreign sound has something alluring, or because they are better than those bred in this country. Common sense would indicate that the buyers know what they are doing, and that their purchases were made for what was considered superior merit. In further proof of the value of sheep from across the waters, is the fact of the advertisements emphasizing the imported idea. It requires no great skill for an American to go over to England and deal with an honest breeder and secure good sheep, but it does require some skill to keep up the improvements bought, and still improve on the original. How many of our importers are doing this as shown by their work? And these importers are styled breeders and are so accepted, and in reading some of the claims made by them as to the superior quality of their importations over all other breeds, one cannot help smile at the seeming credulity they have that their claims are accepted by the careful thinking breeders and farmers of the country. The statements of men who have made their flocks famous by care and skill in breeding rather than in importing, should be worthily considered, but statements made simply for selling purpose, without practical knowledge, should be given little attention. The merino sheep industry of the country is little more distressed than in other breeds and crops. The country has been filled for the last several years with the cry that wool growing must become uprofitable. That mutton raising as surely would become a bonanza to any who engaged in it. That the mutton breeds were to usurp the prestige so long held by the merino, and that those breeding thoroughbreds or grades must come in out of the wet and join the fast growing army of the mutton breeders and importers. The desire for a change in methods which is strikingly American, as well as the hope of receiving earlier returns from breeding have caused large numbers of farmers to engage in breeding for mutton. This has largely stimulated the sale of course wool rams, mostly lambs, and correspondingly decrease the sale of merinos. The temporal benefit afforded those who thus breed, seems to have subsided and a corresponding distrust of that business is plainly discernible. The wool, the secondary factor in that class of sheep, has depreciated in the same ratio with fine wool. The large numbers of half and quarter blood lambs which have been thrust on the market have caused a sharp decline in their values, and should the protection now afforded the American or Michigan breeder of seventy-five cents per lamb be taken off, as it is very likely to be, and the advantage in that direction has ceased. The prices of the mutton bred sires have been lessened in past year very materially in the vicinity in which I live. Ram lambs for breeding purposes have been sold from peddling wagons from five dollars to whatever price could be agreed upon between buyer and seller, showing conclusively, that the bubble of high prices in the direction mentioned has collapsed and farmers breeding them will have the same uncomfortable problems to meet that are disturbing the breeders of merinos and their grades.

These matters of history are stated to call the attention of merino breeders to existing facts, hoping thereby to arrest the seeming destruction of flocks of high value, and which (unless all precedents are changed) will soon appreciate in value and interest, and be a source of profit and pride

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to their owners. If the statements made with reference to other branches of farming operations be true, it is seen that wool growing is on a par with the rest of the farm productions, and should be pursued in connection with mixed husbandry. All breeds of sheep are essential and hold a worthy place in our farming operations. All have distinctive qualifications, and all should be bred with care, and the best points in all the breeds be brought out. The idea sought to be enforced that one class of sheep are par excellence above any other, or all breeds or classes, is the merest moonshine, used to gull the unwary. The merino sheep industry in Michigan in the past has been highly beneficial to the State as well as the breeders themselves. Men of energy and intelligence have for the last twenty or thirty years been actively engaged in this industry. Michigan holds fifth place in the union as a wool bearing State. A vast amount of wealth has been added by their ability to pay for their cost and care. They have cleaned up the waste places, they have added largely to the fertility of the farms, and by the Breeders' Association a great amount of good has been accomplished socially and intellectually. One year ago there were in this State in the neighborhood of two hundred breeders of thoroughbred American merinos. All had faith in the business, and were well pleased with the outlook. The same causes, whatever they may have been, that caused distrust and a fear in all financial industries, have caused the same in sheep breeding and wool growing. The same causes which shall bring confidence and prosperity in other directions will bring confidence and prosperity to wool growing. Sheep have always proved the farmer's friend, when properly bred and fed, and they will always hold the same relative position to other industries as in the past. If obliged to compete with the cheap labor and cheap lands in foreign countries in the production of wool and mutton, if the markets of this country, which the American farmer helps sustain, are to be opened to aliens, thereby giving them an undue advantage, and discriminating against the Michigan breeder, the ingenuity of our people will contrive some way whereby we will be able to compete successfully with all foreign competition. If in no other way, by another change in revenue legislation. The merino has stood the test imposed upon him for a long period of time, and will still be able to respond to all future claims. The sheep that will grow a large amount of good wool, suitable for the finest woolen fabrics, will always be in demand, and with the exception of these periodical disturbances, will be remunerative. In point of purity of blood, the merino has no equal. In its history can be traced the history of nations. It is the best adapted for all conditions of soil, climate, of any known breed. It is at home on the plains of Texas or the sterile hills of New England. In dry seasons or wet it thrives and prospers. It stands the rigors of Arctic winters or the tropical heat of summers. It is the most profitable wool bearing animal known. It furnishes a fair amount of good mutton. It lives to a good old age, and yearly yields a revenue in wool, and raises a valuable addition to the flock. Like the short-horn, they are the general purpose friend of the farmer. Improvements in any class of stock must come from the improved thoroughbred.

Thoroughbred flocks should be bred with the greatest care; attention being given to the proper requirements of the times in which they are bred. They should be bred without mixture or alloy. No cross bred animal is as good as a proper specimen of either breed in its pure state. This being true, it is not good policy to breed in such a direction, except it be to

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dispose of the increase to appease some particular demand. The characteristics and purposes for which the merino has so long been bred, differ so radically from those in the mutton breeds, that a crop between the two should never be retained for flock purposes. No uniformity or type can be thus obtained, a quality that every flock should excel in. To my brother merino breeder I would say, keep right along with your merinos. Do not become discouraged at the present reverses and sacrifice your valuable flocks produced at a cost of so much time and money, for the time is not distant when the demand for merino sheep will be good, and the spirit of improvement and progress will usurp the place of fear and discouragement and the merino sheep industry in Michigan will be one of the important industries in her varied agriculture.

THE JERSEY COW.

WHAT SHE HAS DONE, AND WHAT SHE CAN DO FOR THE DAIRY FARMERS OF MICHIGAN.

[A paper read by John I. Breck, Esq., of Jackson, before the Michigan Improved Live Stock Breeders Association at Lansing, December 20, 1893.]

Purely and solely for the lack of opportunity the Jersey cow, it is to be regretted, has not been able to show to any great extent, what she can do for the dairy farmers of Michigan. And this for two reasons: First, there are comparatively few dairy farmers in Michigan; and second, comparatively few of those have had what the skeptics call the temerity to give her this opportunity. What cattle our farmers have heretofore raised have been mostly of the beef type, or of the so called "general purpose type." Nor until quite recently has dairying become an interest of any great importance in our State, and it will be some time yet before she can hope to compare favorably in this regard with her great sisters of the northwest, viz.: Wisconsin, Illinois, Minnesota and Iowa. So far as her being adapted by nature to compete successfully with them there can be no serious contention. Her soil is as fertile, her climate more equable and salubrious. She has an abundance of pure, living water, while last and by no means least her farmers are fully as intelligent and progressive. I say "last but not least" for the reason that successful dairying requires both a high degree of intelligence and well directed energy to carry out the promptings of that intelligence. That our farmers possess these requisites is beyond question. They have the discernment and good sense to realize that a change in the existing condition of things pertaining to farm management is imperatively necessary if they would prosper. They recognize the fact that it no longer pays to raise wheat at sixty cents. Horses are worse than unprofitable. It was always poor management to sell off the hay, corn and oats without returning their fertilizing equivalent to the soil. This, however, has been done altogether too much, until today the fertility and productiveness of our farms is in serious jeopardy, and we must therefore adopt a system or branch of farming which will stay this great tidal wave of waste, and the balance be transferred to the right side of the ledger. Acting upon this conviction our farmers have scanned the agricultural horizon for available means to accomplish this result, and one by one they discern the fact that in the dairy is their surest and speediest

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hope. They are profiting by the sad experiences of New York and New England, where hundreds, yes, thousands of farms have had their natural fertility exhausted and have been abandoned as absolutely worthless, but which are now rapidly being reclaimed, and made productive beyond the rosiest dreams of the most hopeful, simply by installing good dairies upon them.

It is a well known fact to chemists that where butter dairying is carried on, less than one-tenth of one per cent of the fertility of the soil is taken off; or, in other words, butter contains less than one-tenth of one per cent in manurial value of the fertility, while grain farming extracts from thirty to sixty per cent.

Having determined then to embark in the dairy business, the farmer of Michigan, as otherwhere, is confronted in his first step by the all-important question, "Which breed of cattle will return to me the greatest net profit." Not which one will give the largest amount of milk, nor the most pounds of butter, nor which will consume the least amount of food; but which will leave in my hands the most money at the end of a given period, after paying all the expenses of producing and marketing, including fair compensation for my labor? Obviously it will be that breed which gets the largest amount of valuable elements of milk out of the same or a given amount of food, and with the least labor. But in this answer another question is suggested, viz.: What are the valuable elements of the milk? The answer is, emphatically, its solids. Not butter-fat alone. Not casein alone. Not milk sugar alone. Not the fixed salts alone—but all of its solid elements. The principal constituent of milk is water, it being simply a vehicle for the solution and suspension of the solids, and is absolutely of no other importance whatever. It follows, then, that the smaller the quantity consistent with making the solids available the more desirable it is. The ordinary composition of milk is about as follows, on the average: Water, 87.3%; fat 3%; casein 4.8 %, milk sugar 4.4%, and the fixed salts consisting of the phosphates of lime, magnesia and iron, the chlorides of soda, and potash, combined with casein 5%. Hence it will be seen that the cow giving 20 lbs of milk which contains 2 lbs of these solids is of greater value, other things being equal, than one giving for instance 40 lbs containing the same 2 lbs of the solids in the same proportion. But, says one, suppose we are to sell the milk regardless of its solids? The answer is that the time is past when you can sell all grades of milk at the same price. If our State does not establish a legal standard for it, as it should do, the customer certainly will.

Already probably a majority of the creameries of Michigan pay for their milk according to the actual amount of butter fat or of the solids it contains, and the time is not far distant when all of them must do so or cease operations. City consumers are becoming more and more enlightened as to the relative values of milk and they will no longer pay five cents for a quart of milk unless it contains that amount of value.

But we have determined only in a general way what breed to adopt; what we wish to know is the specific name of that breed. In determining a line of action for future conduct the most practical way is to be guided by what has been done in the past if we have had such a guide. We might inquire what the various breeds have done in the world at large. But some might interpose the objection, to such

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logic that the soil, climate, environments or other circumstances might not be the same in Michigan. Such objection would not be well taken, but for the sake of the argument we will admit that it would. We arrive then at the question, what have the different dairy breeds done for the Michigan dairy farmer? But as it is not the province of this paper to review them all, but simply the Jersey, we must content ourselves with being restricted to them. Upon this branch of the subject it is to be regretted that as yet no statistics of our State nor of any association within it are available for throwing any light. We must have instead the isolated experiences of the individuals and accounts kept and figures given by them. These, however, are very unsatisfactory for the reason that very few farmers keep a correct account of their receipts and disbursements. Last February, as President of the Michigan Jersey Cattle Breeders' Association, the writer sent out upwards of four hundred blanks to jersey breeders requesting information on these very points. Upwards of one hundred of these blanks were returned filled out in various degrees of completeness. Although the net profit of their herds was not given in very many instances, yet one fact was very prominent, and leaves no ground for guess work, and that was that Jersey products almost invariably brought prices higher than the general market. Many of them reported butter sold at 30c the year around, and very many at 25c. In only a few cases was it reported to have been sold at a less price, and then only when varying amount above family wants was disposed of and the general market relied upon. Milk was reported to have been sold at 6 to 10c per quart, whereas the milk from the common cows never sold above five cents unless labeled with a Jersey trade mark. One man sold all his cream at 50c per quart and required only four to five quarts of milk for each one of the cream. Fiften reported net incomes from $35 to $84 an average of $60 per cow. As the value of the offspring of Jersey cows and the prices obtained for them, a personal incident will serve to illustrate. Last spring the writer chanced to want a number of heifer calves from recorded sires and dams for utilizing skim milk. I wrote over one hundred letters to Jersey breeders in Michigan, giving them the preference over those outside the State, offering $20 each for all I could get of heifer calves of any color, and of any age over one week. I received a great many replies stating that the writers had what I wanted, but not at grade prices, and many said they themselves would like to purchase some at that price. But not a single calf did I get at $20. I purchased some, but at a considerable advance above the amount. I have refrained from giving instances which have fallen under my personal notice of what the Jersey cow has done for Michigan farmers for the reason that your observations are as valuable and perhaps as numerous as my own, and I am sure they would all lead to a favorable conviction. Instances could be given by those present of large numbers of men in Michigan for whom the Jersey cow has not only done well, but wonders. I might enumerate many such, but will forbear and say simply that I have never heard or known of a single person who has fairly tried a jersey cow which was a fair representative of the breed, but that he or she was so well pleased with the innovation that they could not be induced to backslide.

We now come to the second and most important branch of our subject: What can the Jersey cow do for the dairy farmers of Michigan? This might be answered in general by saying "What she has done she can do." But this would not be satisfactory to us nor fair to her, because she can

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do infinitely more than she has yet done, if only given the opportunity. It used to be said that the Jersey was the rich man's cow, intended principally to decorate his lawn, to be made a pet by his children, and only incidentally to provide a meagre amount of very rich milk for family use. Formerly choice specimens changed hands at fabulous and even incredulous prices, as high as $15,000 being actually paid and $20,000 asked and refused for a single individual.

Small wonder they had not the opportunity to demonstrate their profitableness for practical farmers. Since, however, the prices have come down so as to be within the reach of farmers, she has demonstrated with astonishing rapidity her superiority in every branch of dairying. Since the invention of the Babcock testing machine, which is to dairying what the invention of the printing press was to education and steam was to transportation, the public have been rapidly and steadily settling into the firm conviction, which cannot be shaken, that the milk of Jersey cows contains more of valuable ingredients, in proportion to the food consumed and the care required for getting them into merchantable form, than that of any other breed. And why should not this be so? If there is any virtue whatever in heredity, if there is any force in the theory of prepotency, if there is any wisdom in the law of natural selection; if, in fact there is any possibility of progressing towards an ideal in anything, then we shall expect the jersey cow to be pre-eminently the one for any feature of dairying. She has been bred in absolute purity "from a time whence the memory of man runneth not to the contrary." More than 100 years ago laws were enacted by the government of the island of Jersey prohibiting under caustic penalties, the admission of any foreign cattle into the island. Every drop of blood in the veins of every animal recorded in the herd register of the A. J. C. C. traces its fountain source to the island of Jersey. Few families of men can trace their ancestry for so many generations, or boast of such royal lineage. She has been bred by men of the keenest perceptions, upon the most approved principles of reproduction and procreation, and for the single purpose of putting the utmost possible amount of her food into the form of the choicest possible merchantable dairy products. As the result of this wise conduct the Jersey has been developed to such a high degree of prepotency as to reproduce to an almost incomparable extent her good qualities. Jersey grades almost invariably show to a marked extent the characteristics of pure bred ones. And let me say in passing that in one way this fact is a very injurious one to the breed and breeder, for the reason that very many grades are unscrupulously palmed off as full bloods, and if they happen to possess an undesirable quality, which they sometimes do, the result is an injury to all pure breds and consequently to the breeder. One poor animal will injure any breed of live stock more than a dozen extra fine ones will help it, for the reason they are always more particularly noticed and their bad qualities cast upon the seven winds of heaven. No reasonable man expects as good results from crossing pure breds upon alien or adverse blood as when bred in their purity. No man expects to get a first class trotting horse by crossing a trotting bred animal with a shire or a percheron. While Jersey grades in general are an improvement over native or common cows, yet they can never be as good as pure *breeds*. Both of these propositions, or the correctness of them, was demonstrated in the most practical manner by the famous Bovina cow census taken in the fall of 1892, in Delaware County, N. Y. To the same effect are all facts where figures

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are correctly given, and the circumstances and conditions are similar. Mr. H. P. Carpenter, a creamery man of wide experience, says (J. B. '93 p. 7), "In a creamery where the milk is put into the pool by the fat test system it pays well to keep Jerseys, and it is folly to produce and sell milk with the average dairy cow." In his creamery at Ligonier, Ind., there were 80 patrons and the milk from only one herd showed above 5% fat, and they were Jerseys. At the N. Y. Experiment station a test was made with Ayrshire, Guernsey, Halderness, Holstein and Jersey cows for one month, which showed that the Jersey gave the greatest amount of butter from the least milk. A dairyman on a hill farm in Bradford county, Pa., has a herd of 27 Jersey cows which made an average of 300 lbs. of butter during the year 1892. He says, 'The best average yield per cow per year before we kept Jerseys was never above 175 lbs., and that only once, often falling below 150 lbs."

In a Tennessee station bulletin 16 cows were reported tested for food, cost of product, 11 being Jerseys and 5 Holsteins last (J. B. '93 p. 225). But why multiply examples, as they all show that under like conditions the pure bred Jerseys stand ahead of all others.

Only a word as to public and private tests which have been made. Over 2,000 of them have been made of Jersey cows testing from 14 lbs. to 46 lbs. of butter in seven days.

Most of these have been private tests, but in most cases, I think, were made by individuals who have no interest in the cow, while 38 have been made by sworn committees and under the direct supervision of the A. J. C. C. It is a noticeable fact that those cows making the highest tests, viz., 46 lbs., 39 lbs. and 36 lbs., were officially tested and are to my mind just as reliable as the trotting records of Nancy Hanks, Directum, or any other horse that ever made a record. But I do not point to these records as a safe guide for the farmer or dairyman to go by, for the reason that the cost of the food consumed in making them was of secondary consideration. But it is a fact that cannot be controverted that Jersey cows have been and can again be made to produce as high as 25 lbs. of butter in a single week and 778 lbs. in a single year at a profit. No other breed can compare with them in the number of tests, while no other one has made any official tests whatever. Although as I say these tests are not the best available guide, yet they reasonably point to the Jersey as the most profitable dairy cow.

Another fact which is a straw showing the direction of the current, is the relative spread of the Jerseys as compared to other breeds. The books of the various breeds show that more Jerseys are being bought and sold than all other breeds combined, their closest rivals in this respect being their first cousins, the Guernseys. And I think if we could ascertain to a mathematical certainty, that we would find a larger percentage of them are being purchased by practical farmers and dairymen who buy them for the money they can make off their products.

And finally, as the cap sheaf to the fabric of fame reared to the Jersey cow and by her own self upon her merits, and settles beyond peradventure her proud position at the head of all dairy breeds, are the tests just closed at the World's Fair. She there demonstrated to the whole world, under conditions and circumstances which were as fair and open as the ingenuity of man could possibly make them, that she possesses in the highest degree all the qualities desired in a dairy cow. She was first in amount of milk,

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cheese and butter, and the lowest in cost of production per pound of each. Of course there are the usual number of doubting Thomases who will not be convinced by the results of these tests. But with the great majority of the reasonable and fair minded men no more proof will be needed, and no explanations of those offered, and no ifs nor ands will change the verdict. Of course her most ardent admirers will not claim that she will give as much milk as the Holsteins. Nor did Jersey breeders generally expect her to surpass in this respect the Guernseys and short-horns at the World's Fair.

So far from this being against her, however, it is on the contrary strongly in her favor, for the reason that the less milk one has to care for the less time, labor and expense it requires. And as separators are coming more and more into general use this quality will be more and more appreciated. It is a slow process at best to run milk through them.

In conclusion, I think it will be apparent that the Jersey cow can and will do more for the dairy farmers of Michigan than will any other breed; that she can reasonably be relied upon to return to her owner a net profit of $25 to $75 per year after charging her with all the expenses for care and keeping.

She will continually increase the fertility of the farm, and therefore enhance its productiveness and value. In addition to this she is a "perpetual dream of delight" to her owner and to his family. She is unrivalled as an ornament to a lawn or a picturesque landscape; her disposition is naturally gentle and affectionate, and she responds promptly to good care and treatment. She milks evenly throughout the year, being idle on an average of not to exceed three weeks, between calves, and her milk grows richer with the advance of the milking period. She can adapt herself readily to almost any circumstances, thrives well in any climate, is hardy and healthy, the many vile calumnies and falsehoods to the contrary notwithstanding. In short, she combines more admirable qualities from the standpoint of the practical farmer and dairyman than "All the cattle on a thousand hills," and fills to the brim the old poetic measure of beauty, "Handsome is as handsome does."

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MICHIGAN STATE AGRICULTURAL SOCIETY.

REPORT OF THE PROCEEDINGS FOR 1893.

The Columbian Exposition or World's Fair being held at Chicago, the Michigan State Agricultural Society, in common with several other states, held no fair in 1893.

No election was held, and the officers held over as follows:

PRESIDENT—WILLIAM BALL, Hamburg.
VICE PRESIDENT—G. W. BEMENT, Lansing.
TREASURER—C. W. YOUNG, Paw Paw.
SECRETARY—I. H. BUTTERFIELD, Lansing.

Society address, Lansing.

EXECUTIVE COMMITTEE.

EUGENE FIFIELD	Bay City, Bay County.
L. B. TOWNSEND	Ionia, Ionia County.
F. H. LATTA	Battle Creek, Calhoun County.
M. J. GARD	Volinia, Cass County.
L. W. BARNES	Byron, Shiawassee County.
W. P. CUSTARD	Mendon, St. Joseph County.
H. H. LARNED	Lansing, Ingham County.
M. P. ANDERSON	Midland, Midland County.
C. E. LOCKWOOD	Washington, Macob County.
W. E. BOYDEN	Delhi Mills, Washtenaw County.
E. W. HARDY	Osceola Ct'r, Livingston County.
FRANK MAYNARD	Jackson, Jackson County.
F. L. REED	Olivet, Eaton County.
N. J. KELSEY	West Le Roy, Calhoun County.
H. R. DEWEY	Grand Blanc, Genesee County.
H. S. FRALICK	Grand Rapids, Kent County.
JOHN LESSITER	Cole, Oakland County,
H. H. HINDS	Stanton, Montcalm County.
J. P. SHOEMAKER	Amsden, Montcalm County.
F. HART SMITH	Somerset, Hillsdale County.

EX-PRESIDENTS.

M. SHOEMAKER	Jackson, Jackson County.
CHARLES KIPP	St. Johns, Clinton County.
E. O. HUMPHREY	Kalamazoo, Kalamazoo County.
W. L. WEBBER	East Saginaw, Saginaw County.
GEO. W. PHILLIPS	Romeo, Macomb County.
PHILO PARSONS	Detroit, Wayne County.
WM. CHAMBERLAIN	Three Oaks, Berrien County.
A. O. HYDE	Marshall, Calhoun County.
T. W. PALMER	Detroit, Wayne County.
JAMES M. TURNER	Lansing, Ingham County.

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PROCEEDINGS OF THE EXECUTIVE COMMITTEE AT THE REGULAR WINTER MEETING.

The executive committee met at Hudson House, Monday, Jan. 8, at 8 o'clock p. m.

Called to order by the president.

Present, Messrs. Reed, Dewey, Lessiter, Hinds, Smith, Hardy, Fifield, Townsend, Latta, Custard, Larned, Anderson, Lockwood, Chamberlain, President, Secretary and Treasurer.

Reading minutes of last meeting dispensed with.

President read his address as follows:

PRESIDENT'S ADDRESS.

Gentlemen of the Executive Committee:

Since our last meeting another year has been added to the history of the Michigan State Agricultural Society. The cloud of a heavy debt still obscures its horizon, which (if not liquidated in the near future) bids fair to annihilate an institution which has for many years been of incalculable benefit to agricultural and manufacturing interests in Michigan. The present situation of the society is a peculiar and very critical one. For over forty years the Michigan State Agricultural Society has followed the Bohemian plan of life, wandering from place to place as seemed best for the interests involved. Sometimes it had a plethoric treasury and again only enough for scant subsistence. The pioneer work which it had so well done when the country was comparatively new, was no longer needed. Strong, well managed county and district societies were organized and located at different points in the State. The large amounts of money needed to fit different fair grounds suitable for State fair purposes in its wanderings reduced its means largely, and it was the judgment of the executive committee that a permanent location, if a suitable one could be secured, for holding its fairs would be preferable to the rambling policy that had prevailed for so many years. Several propositions for a permanent location were made from different cities, among which one from the Central Michigan Society located in the city of Lansing. The proposition from the Central Michigan was thought to be the most satisfactory, and after due consideration was accepted. The conditions, when completed, were as follows:

The Central Michigan deeded its franchises to the State Society free from debt, to be owned and controlled by the State Society, so long as it held in Lansing on its grounds a yearly exhibition. The State Society was bound by agreement from mortgaging its grounds, and a reversionary right given, by which the Central Society should again become owners if the State Society failed to hold its yearly fairs as mentioned above. After the agreements between the two societies had been properly ratified it was found that the buildings on the grounds were inadequate for the needs of exhibitors. A new grand stand was a necessity. An official building was needed. A large amount of grading and filling had to be done. Horse and cattle stalls had to be built. Sheep and swine

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pens were constructed, fences built and repaired and much underdraining was done. Many other needed improvements were added, all costing a good many thousands of dollars. These improvements were made upon the credit of the society, backed in some instances by its friends. These improvements are all permanent, and in case the State Society is obliged to relinquish its claim, they will revert to the Central Michigan Society. Several fairs have been held since the arrangements spoken of were made, and until the last one fairly successful, pecuniarily, and highly successful in point of exhibits. The one held in 1892, owing to continued rainy weather, was financially a failure. About seventy per cent of the premiums awarded are yet unpaid. The indebtedness of the society in 1892, Oct. 1, was $17,873.81, besides the amount due for premiums amounting to (I believe) between five and six thousand dollars. The interest on the debt has been growing all the time until now the entire indebtedness of the society is about $25,000.00.

How this indebtedness is to be met and guarantees given that premiums will be paid, should you conclude to hold an exhibition in the future is a problem, the solution of which is not clearly in sight. The best thought of this board should be used in deciding what is best to do. The debts of the society are debts of honor, and I feel warranted in saying, that every member of the committee feels humiliated by the position he is in. Last year it was thought by some that legislative aid could be secured. The society is a child of legislation. The last legislature was asked to assist the society enough to pay its yearly premiums (including those past due) for two years. But the economical congregation of legistive talent that could form new judicial districts for political purposes and make a place for a defeated candidate at a good salary, that could add a good round sum to the salary of the supreme court judges, pass jag cure bills and much other obnoxious legislation, would not aid to the amount of 1-100th of a mill on a dollar's worth of valuation of the taxable property of the State, to aid in assisting a struggling State institution to pay honest debts.

The property under the control of the State Society is worth two or more times the indebtedness of the society, which indebtedness was incurred in making the grounds more valuable for exhibition purposes. At a meeting of the business committee two or three weeks since a plan was submitted, that if carried out, would no doubt relieve the society from embarrassment caused by making the improvements alluded to. The plan was as follows: That the Central Michigan Society waive its objections and allow the State Society, in conjunction with the Central Michigan, to mortgage the fair grounds for enough to satisfy the indebtedness of the State Society and give it a small working capital. The State Society in the meantime to honor all life membership tickets of the Central Michigan Society, still being bound to lose any rights in the grounds if it violated any of the provisions in its agreement with the Central. This plan has not, as far as I can learn, met with as much favor from the business committee of the Central Michigan Society as was hoped, though some of that committee are known to be favorable to the plan. I hope that some arrangement may be made by which both societies may be benefited and a yearly State exhibition again be held in the city of Lansing. The State Society, in good faith, incurred the debt by the needed improvements made on the grounds. If it is obliged to go out of existence on account of this debt and in a manner not palatable to honorable men, it will be a sad

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commentary on the thrift, business energy and generosity of the Central Society. The citizens of Lansing did nobly in aiding the Central Society to clear its indebtedness. The State Society in its faith of future success in holding its fairs in the Capital City incurred a debt in making the fair grounds more beautiful, and also better adapted to a great State exhibition. The State Society, the Central Michigan Society and the intelligent citizens of Lansing and vicinity have a common interest in the success of a society which has always kept in the lead of agricultural and manufacturing improvement. The most rigid economy has been observed in the management of the society's business since the fair was located in Lansing.

It is a difficult matter to make suggestions as to the future when so much remains in doubt. A resolution was recently passed by the business committee of the Central Michigan Society to the effect that if the State Society saw fit to hold a fair in 1894, in some place outside of Lansing, its privileges should not be forfeited provided certain conditions were complied with, which compliance has been acquiesced in. This action is good, as far as it goes, but it does not relieve the State Society from annoyances which might be made by its creditors, should it hold a fair during the coming fall. Should overtures be received from some locality which if accepted, would warrant success in holding a fair, some arrangement should be made with the creditors of the society that would prevent any unpleasantness or legal trouble. Knowing the members of the board as well as I do, I am safe in saying that if any plan can be adopted that looks like success, every member will work with a will to make it one of the best exhibitions the State has ever held. I have thought best to state plainly the condition in which the State Society is placed, hoping that some solution of its difficulties may be found and it be enabled to pay its honest debts and go forward toward new achievements in the future, a benefit to agriculture and its kindred arts and an honor to the State in which we all take so much just pride.

A portion of Article two of the Constitution relative to the election of officers reads as follows:

ART. 2. The officers of this society shall consist of a president, vice-president, secretary and treasurer, who shall hold their offices for one year, and an executive committee of twenty members, ten of whom shall be elected annually to hold their offices for two years, the term of office to begin on the second Monday in January succeeding their election. All of said officers shall be elected by ballot by a majority vote of the members of the society voting at its annual meeting, which shall be held during the week of the fair, and shall hold their offices for the time named, or until others are elected or appointed in their places.

There was no fair held in 1893, and hence no election of officers. The attention of the board is called to this clause in the constitution that it may take whatever action in the matter as seems legal and best for the society.

The following is an itemized summary of expenses for the past year: Winter meeting, $152.90; care of grounds, six and one-half months, $162.50; secretary, $15.00; legislative expenses, $28.19; plumbing, $0.95; insurance, $150.00; postage, $8.67; printing and stationery, $61.25; express, '92 and '93, $2.80. Total, $582.26.

Mr. Larned was authorized by the business committee to rent the grounds to some party to relieve the society from the necessity of paying

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for their care. On July 1, 1893, the grounds were rented to the party who had cared for them for some time for $150 per year. That is the plan of caring for the grounds and buildings at the present time. Should the executive committee deem it advisable to hold a fair this year upon the grounds in Lansing, very little expense will be necessary to put the buildings and grounds in good shape for such purpose. The premium list could be reduced considerable and then be in keeping with the premium lists in many other States, and with the strictest economy, which would undoubtedly prevail, success might again be achieved. The time has come when something must be done if the State society is to live. Every member of the executive committee should feel a personal interest in the success of the society and be willing to put his shoulder to the wheel and work or let some one take his place who will. This meeting of the committee is a very important one. On its action will the future of the State society largely depend.

The positions of the committee are not simply honorary, but are positions of responsibility and trust. The affairs of the society will not regulate themselves. There must be a united and determined effort on the part of every member to make the society prosperous. If it is not thought best to hold a fair in Lansing this year, see what inducements can be found to make an exhibit in some other locality. Don't let the society fail through inertia or irresolution. I trust that the good judgment and business ability of the executive committee will provide some way out of its present dilemma, and that the reverses caused by a two day's rain will, in the end, prove a blessing in disguise.

The secretary made the following report, which was referred to the finance committee.

No fair having been held, the secretary has very little to report. Business orders have been drawn to the amount of $582.26, a detailed statement of which will be found in the report of the business committee.

Respectfully,

I. H. BUTTERFIELD,

Secretary.

The treasurer reported as follows, which was referred to the finance committee:

To the Executive Committee of the Michigan State Agricultural Society:

GENTLEMEN—I herewith submit my report as treasurer for the year 1893.

RECEIPTS.

Amount on hand at commencement of year	$591 84	
" received from H. H. Larned	180 40	
Total receipts		$772 24

DISBURSEMENTS.

Amount paid on business orders	$642 37	
" " " premium checks	47 37	
Total disbursements		689 74
Leaving balance on hand		$82 50

All of which is respectfully submitted.

C. W. YOUNG, *Treasurer.*

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The business committee reported as follows:

To the President and Executive Committee of the Michigan State Agricultural Society:

GENTLEMEN—The business committee report the business transactions for the year as follows:

From January 1 to July 1, D. M. Stem was employed to care for the grounds at a salary of $25.00 per month and house rent. On July 1, Mr. H. H. Larned was authorized to rent the grounds to Mr. Stem at $150.00 per year, Stem to keep the grounds and buildings in order. This it was thought would save some expense and still secure supervision of the grounds. In July the north carriage shed burned. Just how it took fire has not been learned, but there are suspicions of incendiarism.

The companies having policies on the buildings were garnisheed for the amount on this building ($500.00). The business committee thought best to contest the claim and it is still in court. The garnishee plaintiff is one of the creditors of the Society. Policies of insurance to the amount of $10,000.00 on the buildings have been continued. The business of the Central Michigan Agricultural Society for the purpose of protecting its interests, requested the business committee of this society to assign the policies of insurance now held on the buildings to a trustee for the purpose of replacing the buildings in case of loss, and that in consideration of this assignment, the Central Michigan Agricultural Society waives the right of forfeit of title, in case no fair is held on the grounds during the year 1894. This proposition was accepted and the assignment of policies has been made. The receipts for the year have been $146.20 from rent, etc.

G. W. BEMENT,
H. H. HINDS,
I. H. BUTTERFIELD,
Business Committee.

Statement of Business Committee in Detail.

1893.	No. of Order.	Winter Meeting.	
Jan 10.	158.	W. P. Custard, personal expenses	$7 72
	159.	E. W. Hardy, " "	4 80
	160.	L. W. Barnes, " "	4 65
	161.	H. R. Dewey, " "	6 20
	162.	W. E. Boyden, " "	7 10
	163.	Jno. Lessiter, " "	7 25
	164.	J. P. Shoemaker, " "	5 85
	165.	Eugene Fifield, " "	7 50
	166.	C. E. Lockwood, " "	8 95
	167.	F. H. Latta, " "	5 30
	168.	F. L. Reed, " "	6 60
	169.	H. H. Hinds, " "	13 35
	170.	M. J. Gard, " "	7 13
	171.	Wm. Ball, " "	7 05
	172.	W. Chamberlain, " "	11 30
	173.	A. O. Hyde, " "	6 95
	174.	M. P. Anderson, " "	8 15
	175.	F. Hart Smith, " "	8 50
	176.	C. W. Young, " "	6 75
	178.	A. F. Kelsey, " "	2 00
Feb. 13.	182.	Robert Smith & Co., printing proceedings	53 00
			$196 10

Express, Postage and Stationery.

Mar. 2.	184.	I. H. Butterfield, paid express	$2 80
Jan. 10.	179.	D. D. Thorpe, stationery	8 25
1894.			
Jan. 5.	195	I. H. Butterfield, postage	8 67
		General expense	$19 72

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1893.

Jan. 10.	172.	Wm. Chamberlain, expense committee meeting	$9 80
May 16.	188.	Wm. Ball, expense sundry meetings	28 19
Jan. 11.	177.	I. H. Butterfield, salary secretary	15 00
			$52 99

Buildings and Grounds.

Jan. 8.	196.	H. H. Larned, paid work, work on grounds	$18 70
Jan. 10.	180.	Gordon and Black, plumbing	95
Jan. 15.	181.	D. M. Stem, care of grounds	25 00
Feb. 15.	183.	" " " " " "	25 00
Mar. 15.	185.	" " " " " "	25 00
Apr. 15.	186.	" " " " " "	25 00
May 15.	187.	" " " " " "	25 00
June 15.	189.	" " " " " "	25 00
July 1.	190.	" " " " " "	12 50
			$182 15

Insurance.

Nov. 15.	194.	Geo. A. Dyer, policies	$75 00
Nov. 15.	193.	Gillam and Son, policies	15 00
Nov. 15.	192.	Merrifield and Carpenter, policies	45 00
Nov. 15.	191.	J. B. and E. H. Porter, policies	15 00
			$150 00

Interest.

1894.

Jan. 10.	197.	Ingham County Savings Bank, paid on interest	$77 56

Summary.

Winter meeting	$196 10
Express, postage and stationery	19 72
General expense	52 99
Buildings and grounds	182 15
Insurance	150 00
Interest paid	77 56
	$678 52

The report was accepted and referred to the finance committee.

H. H. Larned, superintendent of rents and privileges, reported as follows:

To the President and Executive Committee of the State Agricultural Society:

GENTLEMEN—As superintendent, department of booths and privileges, I submit herewith a detailed statement of receipts and expenditures for the year ending January 8, 1894:

Up to July 1 last, the society was employing Mr. D. M. Stem to care for the grounds, at a salary of $300 per year, and was securing from stall rents and pasturage about $200 per year. Since July 1 the grounds have been rented to Mr. Stem for one year for $150, payable in monthly payments, the lessee to give the grounds and buildings the same care and attention as before, he to receive for his own use such fees and rentals as he sees fit to charge. I believe this change saves $250 per year to the society, with the same benefits as before.

Very respectfully,

H. H. LARNED,

Supt. Booths.

Adjourned to 9 a. m. Tuesday, January 9.

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Tuesday, January 9, committee met. Roll called: quorum present. The following resolution was adopted:

Resolved, That the chairman and secretary of the business committee be instructed to assign the insurance policies of buildings to some proper trustee for the benefit of the Central Michigan Agricultural Society, in case of loss to be made payable to said trustee for the purpose of replacing building. Said assignment to be made on condition that the Central Michigan Society, by its business committee, extend the time for another year of release of forfeiture of title, if State Society does not hold fair on grounds in 1894.

A recess was taken to eleven o'clock a. m.

Met at eleven o'clock.

Mr. Robert Gibbons appeared before the committee and stated that a committee from the Detroit Exposition Company would like to meet a committee of this society, to confer in regard to holding a fair at Detroit this year.

On motion a committee of five, the president a member and chairman, was appointed to confer with the committee of the Detroit Exposition Company and report to this committee.

The president appointed Messrs. Ball, Hinds, Butterfield, Fifield and Young. A recess was taken, subject to a call of the president.

The president called the committee to order at 6:30 p. m. Mr. Gibbons, on behalf of a committee from Detroit Exposition Company, presented a proposition for holding a fair at Detroit. On motion of Mr. Smith, the committee appointed at the afternoon session was authorized to confer farther with the Detroit Exposition Company, and accept the proposition made by their committee for holding a fair at Detroit, if in their judgment a satisfactory arrangement can be made.

The following resolution was offered:

Resolved, That the business committee request the Central Michigan Agricultural Society to join this society in executing a mortgage on the grounds now held by the society, for the purpose of securing the creditors of the society and paying unpaid premiums, and the business committee of this society are hereby authorized to execute such mortgage on behalf of this society, if this proposition is accepted by the Central Michigan Society.

Adopted.

The following was offered:

Resolved, That the president and business committee, with the committee already appointed, are hereby authorized to make all necessary arrangements for holding a fair, fixing date of the same and duration thereof, and that the president be authorized to call a meeting of the executive committee at any time when in his judgment it is necessary.

Adopted.

On motion the committee adjourned.

I. H. BUTTERFIELD,
Secretary.

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LAWS OF INTEREST TO FARMERS.

Copies or abstracts of the following acts are published for the information of farmers and others:

NOXIOUS WEEDS IN HIGHWAYS.

[Howell's Statutes, Volume 1, page 414, Section 1419.]

Every overseer shall cause the noxious weeds within the limits of the highways within the district to be cut down and destroyed twice in each year, once before the first day of July, and again before the first day of September, and the requisite labor shall be considered highway work; and once in every month, from the first day of April to the first day of December, shall cause all the loose stones lying on the beaten track of every road within his district to be removed. Any overseer who shall refuse or neglect to perform the duties required by this section shall be liable to a penalty of twenty-five dollars.

[Session Laws of 1891, No. 160, page 201.]

To require all gravel and plank road companies doing business in the state to cut and destroy all noxious weeds growing on lands occupied by them.

SECTION 1. *The People of the State of Michigan enact,* That all gravel or plank road companies doing business in this State shall, between the fifteenth day of June and the first day of July, and again between the fifteenth day of August and the first day of September in each year, cause all noxious weeds growing on the lands occupied by them in any village or organized township of this State, to be cut down and destroyed.

SEC. 2. In case any gravel or plank road copany shall refuse or neglect to comply with the requirements specified in the first section of this act, it shall be liable in a penalty of twenty-five dollars, to be prosecuted for in action of debt by any person feeling himself aggrieved. Said suit may be brought before any justice of the peace of the county, who shall require of the complainant surety to pay the costs in case he fails to maintain his action. Summons may be served on any agent or officer of the company.

SEC. 3. In case any such gravel or plank road company shall refuse or neglect to comply with the requirements specified in the first section of this act, then it shall be lawful for any highway officer or commissioner to cut or cause to be cut said noxious weeds, between the first and fifth days of July, inclusive, and between the first and fifth days of September, inclusive, in each year, at the expense of the corporation on whose lands said noxious weeds shall be cut, at the rate of three dollars per day for the time necessarily occupied in cutting, to be recovered in any court of competent jurisdiction in this state.

This act is ordered to take immediate effect.

Approved June 24, 1891.

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[Session Laws 1891, page 15.]

Amending an act to require railroad corporations to cut and destroy noxious weeds on land occupied by them.

SECTION 1. *The People of the State of Michigan enact,* That all railroad corporations doing business in this State shall, each year, between the fifteenth day of June and the first day of July, and again between the fifteenth day of August and the first day of September, cause all noxious weeds growing upon the lands occupied by them in any city, village, or organized township in this State to be cut down and destroyed.

SEC. 2. In case any railroad company shall refuse or neglect to comply with the requirements specified in the first section of this act then it shall be lawful for any highway officer to cut said noxious weeds, between the first and fifth days of July, inclusive, and between the first and fifth days of September, inclusive, in each year, at the expense of the corporation on whose lands said noxious weeds shall be cut, at the rate of three dollars per day for the time necessarily occupied in cutting, to be recovered in any court of competent jurisdiction in this State.

Approved March 27, 1891.

CANADA THISTLES.

[Howell, Volume 1, page 589, Sec. 2223.]

SECTION 1. *The People of the State of Michigan enact,* That it shall be the duty of every owner, possessor or occupier of land, to cut, or cause to be cut down, all the Canada thistles growing thereon, or on the highway passing by or through the same, so often in each year and every year as shall be sufficient to prevent them going to seed; and if any owner, possessor or occupier of land shall, knowingly, suffer any such Canada thistles to grow thereon, and the seed to ripen, so as to cause or endanger the spread thereof, he shall, on conviction, be liable to a fine of ten dollars for every such offense.

SEC. 2. It shall be the duty of the overseer of highways in any township to see that the provisions of this act shall be carried out within their respective highway districts, and they shall give notice to the owner, possessor, occupier of any land within said district whereon Canada thistles shall be growing and in danger of going to seed, requiring them to cause the same to be cut down within five days from the service of such notice, and in case such owner, possessor or occupier shall refuse or neglect to cut down the said Canada thistles, the overseer of highways shall enter upon the land and cause all such Canada thistles to be cut, with as little damage to growing crops as may be, and he shall not be liable to be sued in any action of trespass therefor: *Provided,* That when such Canada thistles are growing upon non-resident lands it shall not be necessary to give notice before proceeding to cut down the same.

USE OF WIDE TIRES.

AN ACT relating to rebate of taxes to persons using lumber wagons with wide tires.

[Howell, Volume 3, page 3085.]

SECTION 1. *The People of the State of Michigan enact,* That all persons who shall use only lumber wagons on the public highways of this State with rims not less than 3 inches in width, for hauling loads exceeding eight hundred pounds in weight, for the year ending on the first day of June, in the year of our Lord one thousand eight hundred and eighty-seven, and each succeeding year thereafter, shall receive a rebate of one-fourth of their assessed highway tax for the year eighteen hundred and eighty-seven, and in like manner each succeeding year thereafter: *Provided, however,* Such rebate shall not exceed in any one year three days' road tax to any one person.

SEC. 2. Any person complying with the provisions of section one of this act, who shall make and subscribe to an affidavit that he or she has for the last preceding year of June first, eighteen hundred and eighty-seven, or on the first day of June on any succeeding year thereafter, used only such wagons with rims not less than three inches in width, for hauling loads exceeding eight hundred pounds in weight on the public highways of this State, shall be credited by the overseer of highways of the road dis-

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trict in which such person resides, with one-fourth of the road tax assessed and levied on the property of such person. Such credit shall not exceed in any one year three days' highway tax to any one person, and any overseer of highways is hereby authorized to administer such oath.

AN ACT to prevent the spreading of milkweed in the State of Michigan.

[Public Acts 1891, page 107.]

SECTION 1. *The People of the State of Michigan enact*, That it shall be the duty of every owner, occupant or person having charge of lands in this State, to cut down, or cause to be cut down, all milkweed, asclepias cornutus, growing thereon, or on land between the center of any highway and said lands, or in any highway passing through the same, in each and every year so often as shall be sufficient to prevent said milkweed going to seed; and if any owner, occupant or person having charge of such lands shall knowingly suffer any such milkweed to grow thereon, and the same to ripen so as to cause or endanger the spreading thereof he shall, on conviction, be punished by a fine of ten dollars, together with the costs of prosecution, and in default of payment of the same be imprisoned in the county jail of the county where the land is situated, for a period not exceeding twenty days.

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